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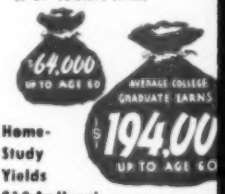

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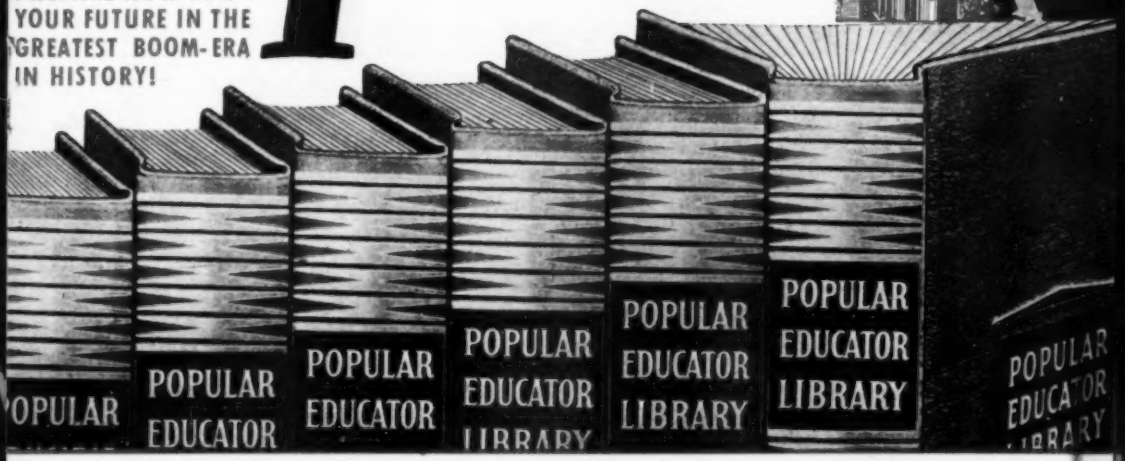

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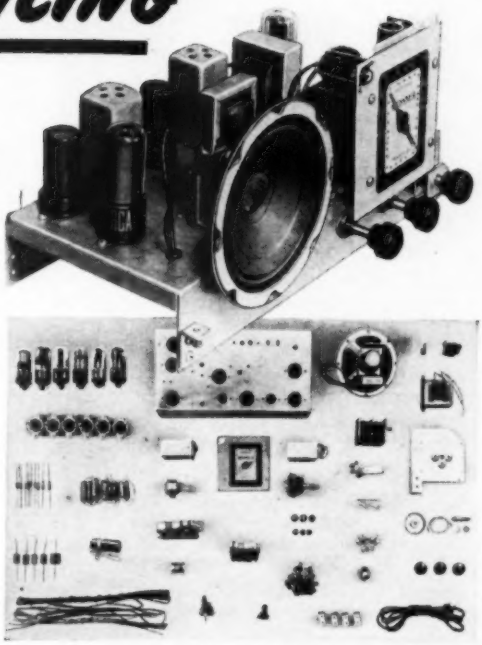

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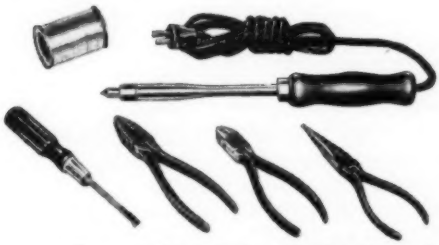

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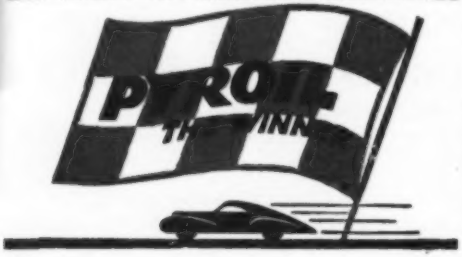

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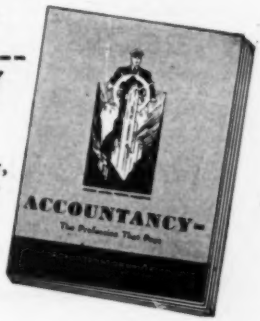

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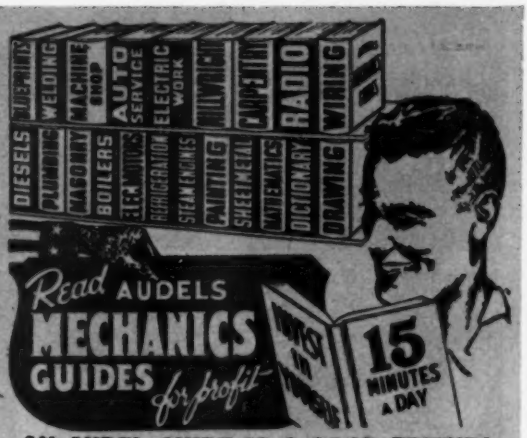

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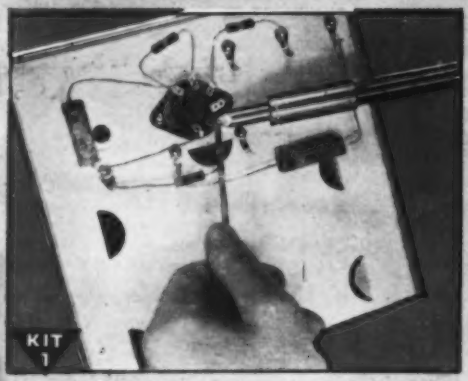

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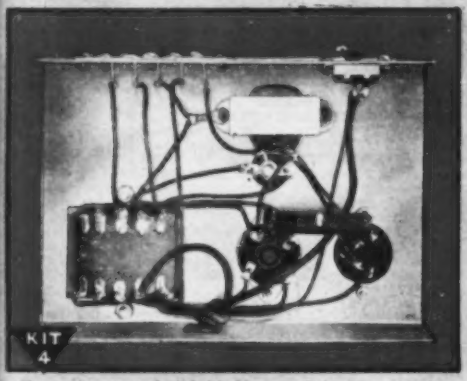

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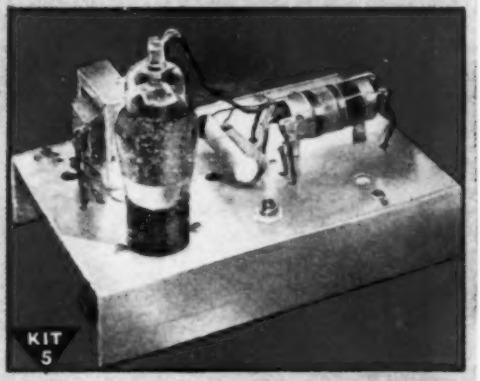

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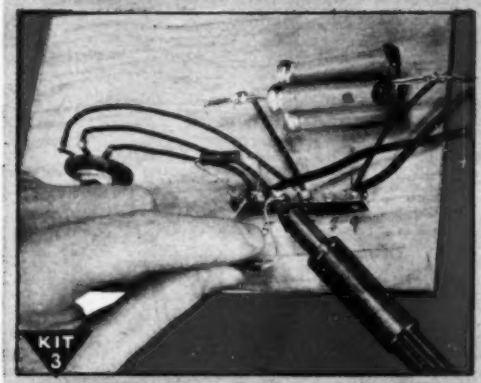

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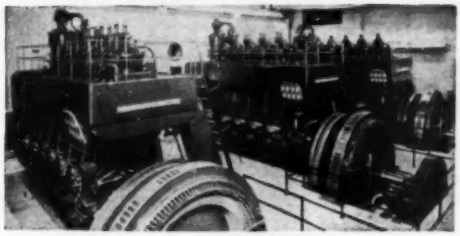

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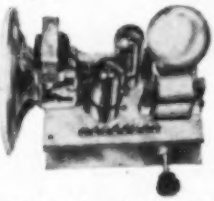

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Letters

A Collector's Cover

Sir:

Congratulations on your scoop in publishing the first magazine cover sent by full-color radio facsimile. The cover and story reflect a high standard in journalism.

I would be interested in knowing if there is considerable interest in the cover as a collector's item in the United States.

ROBERT D. SMITH
Education Division
Institute of Inter-American Affairs
Lima, Peru

So far, interest has centered mainly around the process involved, but the cover (November) will undoubtedly have value as a collector's item to those interested in "firsts."

Everybody's Making 'Em!

Sir:

In your November issue on page 224, you had a picture of a homemade tractor. Here's a picture (below) of one I made.

It's got a V-8 truck motor, two four-speed truck transmissions, a 24-gallon gas tank, and a combined foot and hand clutch

so that it can be driven while walking along beside it. It has a 39-inch wheel tread, with power take-off for dusting.

We have used it two and a half years without a major breakdown. We use it to

INVENTORS

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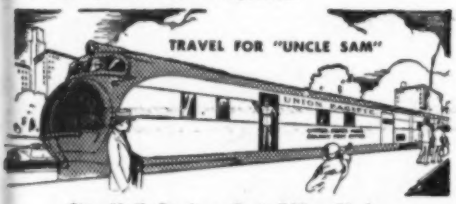

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haul fruit out of the vineyards and orchards, dusting, light cultivating, and seeding. It's so peppy that it ran wild with two drivers who didn't know how to stop it. It took me six months to make it in my spare time. It has such a low gear that with the throttle wide open it will hardly move. It has a high gear of around 35 m.p.h. It's mostly a welded job. Also, the battery is spring-cushioned. It has a double-frame, dual-exhaust, regular tractor air cleaner. It's a very close coupled unit, no drive shaft.

ASHOUN M. ANDRANIGIAN

Kingsburg, Calif.

How Big Is a Nail?

Sir:

On page 139 of the December number is a footnote on how they got the size of nails.

When nails were made by hand, the weight of iron in each nail was figured by the pennyweight of iron. There were 20 grains to the pennyweight, so a two-penny nail weighed 40 grains, and an eight-penny nail 160 grains. That was the standard. My grandfather told me—and he made them.

V. H. BAKER

Tampa, Fla.

This version and the ones PS published all have their adherents—of course Mr. Baker has his grandfather on his side. The pennyweight is usually considered 24 grains.

Atomic Electricity?

Sir:

Our city is about to decide whether or not to grant a 30-year franchise for electric power, and I am writing to you to get your opinion on atomic energy for power.

Do you think there is a chance of producing electric power within five or 10 years with atomic energy? If so, could it be produced much more cheaply than with the methods in use today?

B. R. KANE

The Allen-White Co., Inc.
DeLand, Fla.

It is too early to tell when atomic energy may start commercial production of electricity, but 10 years is probably optimistic. Even then, competition will exist at first only in regions remote from other sources of power. Also, since the cost of distribution often exceeds that of production, this is

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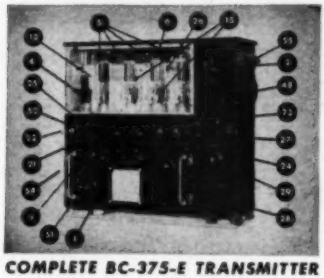

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You get all this: transmitter, tubes, ant. loading unit, dynamotor, five tuning units.

METERS
1. (1) 0-15V AC DC., GE
2. (1) 0-8A RF with thermocouple, GE
3. (1) 0-500 MA. DC., GE

TUBES
4. (1) 10Y (VT-25)
5. (4) 211 (VT-4-C)

COILS
44. (3) RF chokes
45. (1) AF choke .5 hy .1 amp
46. (1) Parasitic Suppressor
47. (1) Tapped antenna loading coil on ceramic form

COILS *(continued)*
48. (1) Continuously variable antenna loading coil with dial-ceramic form

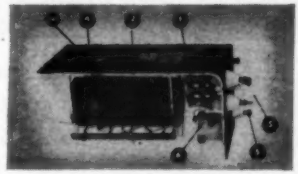
SWITCHES
21. (1) Interlock
22. (1) Test
23. (1) SPDT Toggle
24. (2) DPST Toggle
25. (1) 3 pos. Mallory w/bar knob
26. (1) SPDT Toggle
27. (1) 4 pos., 3 sec. hi voltage band switch w/bar knob
28. (1) 5 pos. hi voltage, band switch w/bar knob

RESISTORS
6. (1) Tapped Resistor 2.7 ohms, 36 watts—3.7 ohms, 26 watts
7. (1) 5 ohms 2 watt, IRC
8. (2) 5 ohms 12 watt, IRC
9. (1) 50 ohms 4 watt, IRC
10. (1) 100 ohms 12 watt, IRC
11. (1) 150 ohms 8 watt, IRC
12. (1) 200 ohms 2 watt, IRC
13. (1) 200 ohms variable, Mallory
14. (1) 2500 ohms 15 watt, IRC
15. (2) 3000 ohms variable, Mallory
16. (1) 4000 ohms 15 watt, IRC
17. (3) 11000 ohms 12 watt, IRC
18. (1) 30000 ohms 1 watt, IRC
19. (1) 200000 ohms 1 watt, IRC
20. (4) 250000 ohms 1 watt, IRC

CAPACITORS
29. (1) 22-118 mmf. variable with vernier dial
30. (1) tube thermal compensating and calibration reset capacitor
31. (2) .0001-1000 V, CD, mica
32. (1) .006-2500V, CD, mica
33. (2) .001-2500V, CD, mica
34. (1) .001-4500V, CD, mica
35. (1) .02-1000V, CD, mica
36. (1) .01-1000V, CD, mica
37. (1) .01-2500V CD, mica
38. (3) 1-300V, CD, mica
39. (1) 1-1-1 3000V GE, pyranol
40. (1) 25 mfd 25V, CD, electrolytic

TRANSFORMERS
41. (1) Microphone trans. single button mic. to single grid
42. (1) Interstage transformer single plate to push-pull grids.
43. (1) Modulation transformer — class B mod. to class C plate

MISCELLANEOUS
49. (1) 8 contact antenna relay—28V D.C.
50. (2) Ceramic insulated flexible couplings
51. (1) 6.3V dial lamp and socket
52. (1) mic. jack
53. (2) .5A-1000V Fuses
54. (3) Sockets with plugs
55. (5) Binding posts
Plus hardware, stand-off insulators, etc.



BC-306-A ANTENNA LOADING UNIT
1. (1) 3 Gang, 5 position, high voltage band switch
2. (1) Tapped inductance with variometer tuning
3. (1) Vernier dial
4. (1) Ceramic insulated flexible coupling
5. (2) Bee-hive feed-thru insulators
6. (1) Capacitor .00024-6000V SANGAMO

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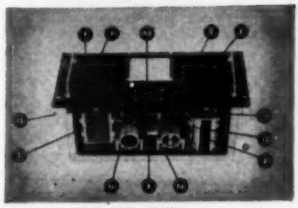

TYPICAL TUNING UNIT
TU-5-B—1500-3000 KCS
1. (2) Vernier dials
2. (1) Variable capacitor, 20-135 mmf.
3. (1) Variable capacitor, 20-156 mmf.
4. (1) Variable capacitor, 8-26 mmf.—neutralizing
5. (1) .00003-2000V capacitor, CD—mica
6. (3) .00009-3000V capacitor, CD—mica
7. (2) .0004-5000V capacitor, CD—mica
8. (3) .0001-3000V capacitor, CD—mica
9. (2) 4 position ceramic band switches
10. (2) 2 RF chokes
11. (1) Tank coil—ceramic form with tapped antenna coupling coil
12. (1) Tank coil—ceramic form
13. (1) Parasitic suppressor
14. (2) Ceramic flexible couplings
15. Plus banana jacks, stand-off insulators

PE-73 DYNAMOTOR
1. (1) Dynamotor 28V DC input—1000V DC output—GE
2. (1) Fuse, 30A 250V
3. (1) Fuse, 60A 250V
4. (1) Fuse, 1A 1000V
5. (1) Relay, 24V D. C.
6. (3) .005-5000V Capacitor, mica—CD
7. (1) .01-1000V Capacitor, mica—CD
8. (2) .01-600V Capacitor, mica—CD

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S-2

only part of the problem. Geographical location, consumer demand, and population density will have to be weighed when the time comes to consider the value of atomic-produced electricity to any one town or city.

Plans that Paid Off

Sir:

I am sending you a photograph (below) of the boat I built from the plans published in your 1938 July and August issues. I had never built a boat before but was able to because of your complete instructions.

The planks are of red cedar and the frames of a Brazilian hard wood named

peroba do camp. It is seaworthy and planes very well. With my motor of eight horsepower, it speeds up to about 25 m.p.h. . . .

OSCAR B. BEZERRA

Rio de Janeiro

That Coin Again!

Sir:

Not to split hairs, but to illustrate how ambiguous and unscientific language can be . . . I quote your concluding syllogistic explanation of the "Heads Up" coin problem (Nov. '47, p. 16): "Two halves make a whole."

Now, two halves do not make a whole if one half happens to be that of a peach and the other that of a pear. Similarly, one half of a "revolution" plus one half of a "roll" do not make either a whole revolution or a whole roll. Furthermore, the "heads up" position of the revolving coin merely reveals that this coin, which originally faced away from the stationary coin, now faces toward it; and this, in turn, proves that the coin has merely made one half of a "roll". . . .

Let's imagine the coins to be replaced by

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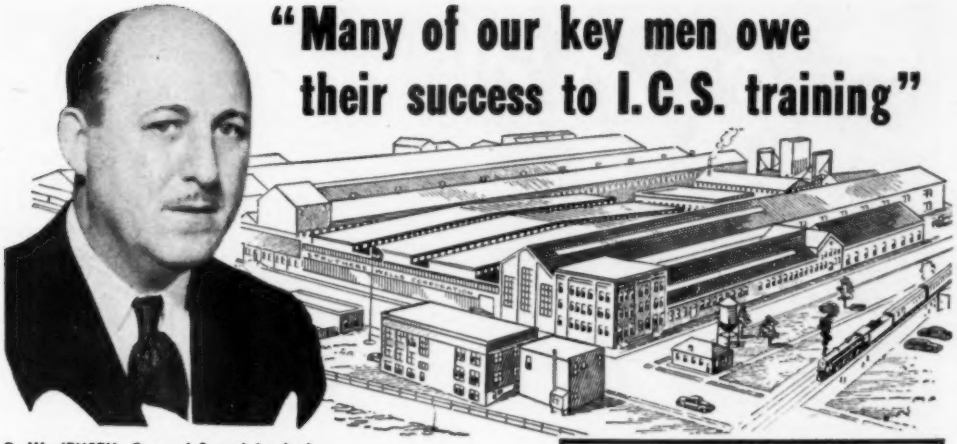

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meshed spur gears, each four inches in diameter. Thus each gear would have a circumference of 12 inches. Then when the traveling gear reached the position of the question mark, it would have used six of its own teeth, but it would also have used six teeth of the stationary gear. Then 12 teeth would represent the full circumference of one of the gears, and the latter would necessarily have made one revolution.

Like Olin Miller's saying: "I'll think it over and let you know"—thus using eight words to say "no"—I think you'll agree that my explanation is—wordy.

JOE BLONDIN
Sacramento, Calif.

That clear it all up, folks?

132,000 Volts Can't Be Wrong

Sir:

I have an inquiry regarding the article on page 147 of the September issue referring to a 52-ton transformer. I have never heard of 132,000 volts A.C. The highest I have known being supplied to an individual company's transformers was 13,200 volts—or 13-2 as we electricians call it.

I am interested in knowing what company supplies such high voltage. . . .

LESTER WM. SCHLODER
Philadelphia, Pa.

Believe it or not, the Marietta Electric Co. supplies the 132,000-volt alternating current. The similarity between this voltage and the lower, more familiar 13-2 is just one of those coincidences.

Pop-Ups Pop Up Again

Sir:

Several of our Chilean readers have noticed the article entitled "Houses Pop Up When Cradle Rocks" on page 115 of the April issue. They are interested in securing further information on the cost, construction, and erection of such houses. . . .

(Mrs.) VIVA DREW HALL
Instituto Chileno NorteAmericano de Cultura
Santiago, Chile

PS welcomes interest from its South American neighbor and is passing Mrs. Hall's request along to the originators of the method.

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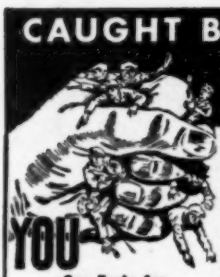

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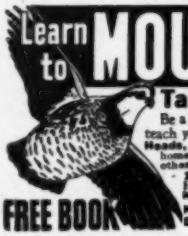

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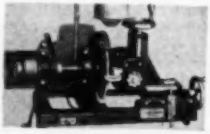

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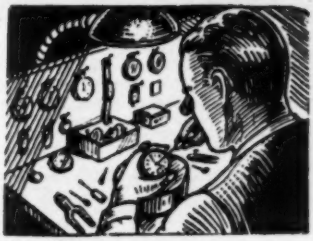

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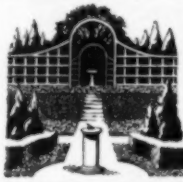

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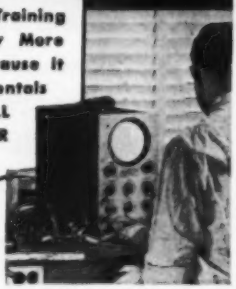

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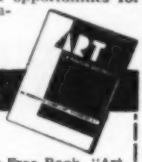

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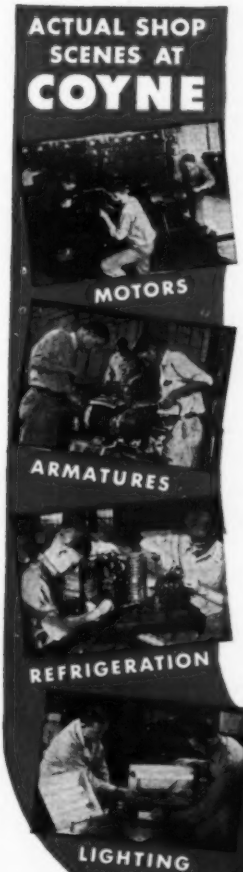

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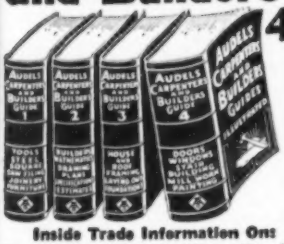

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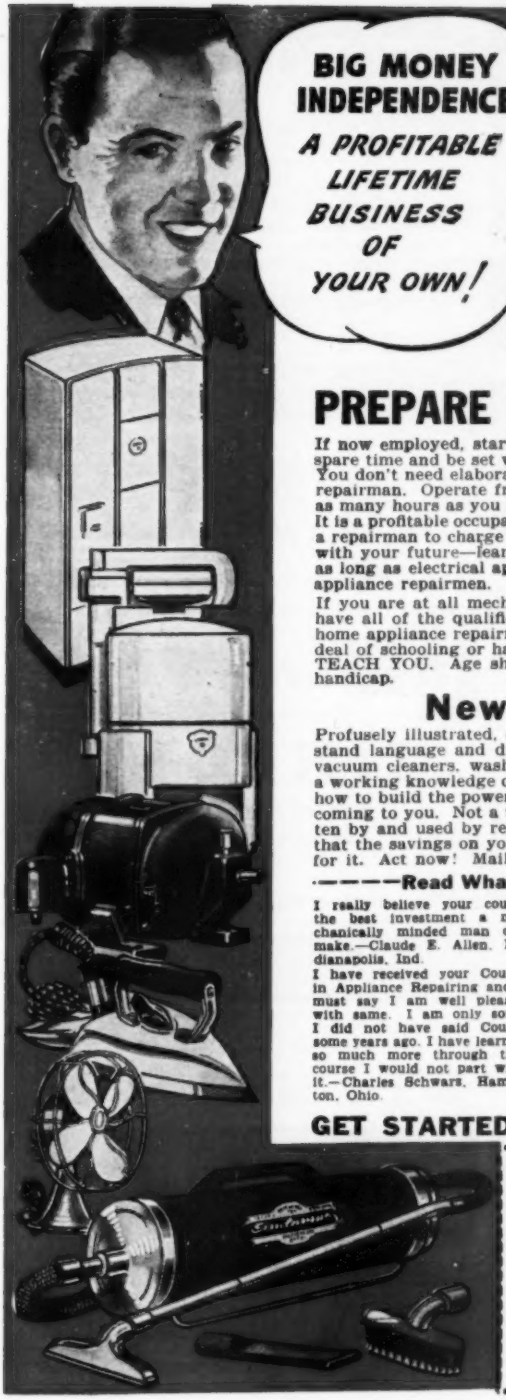

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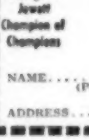

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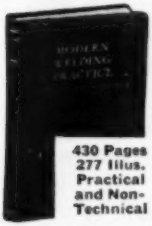

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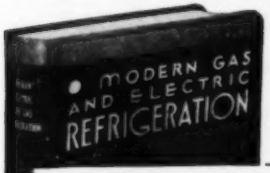

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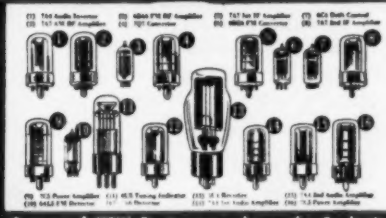

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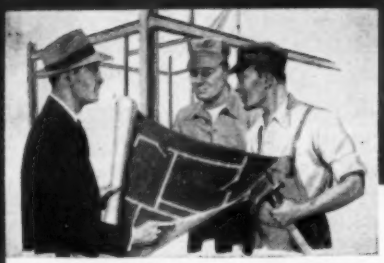

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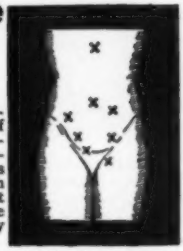

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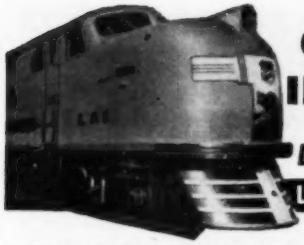

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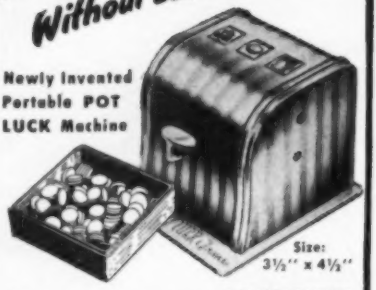

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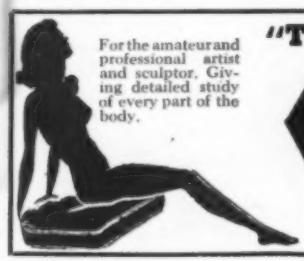

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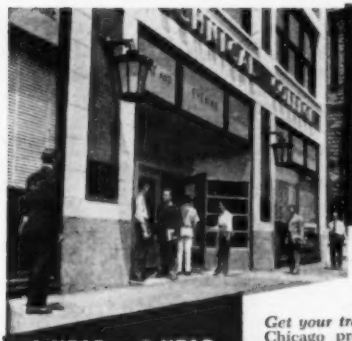

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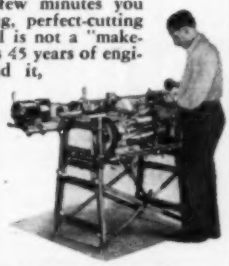

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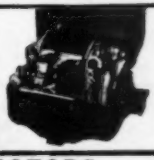

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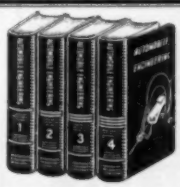

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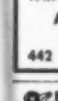

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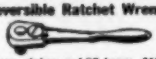

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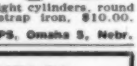

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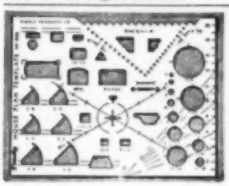

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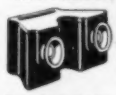

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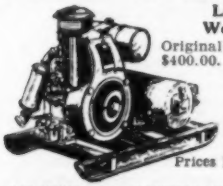

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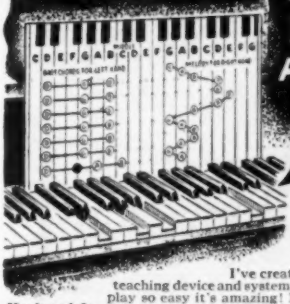

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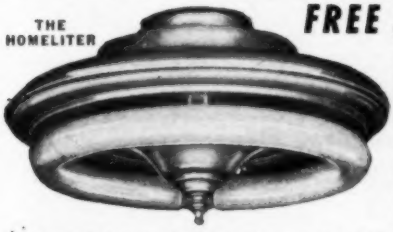

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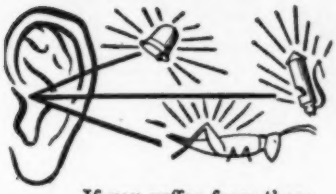

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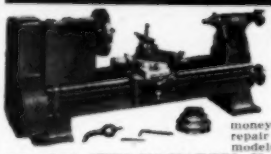

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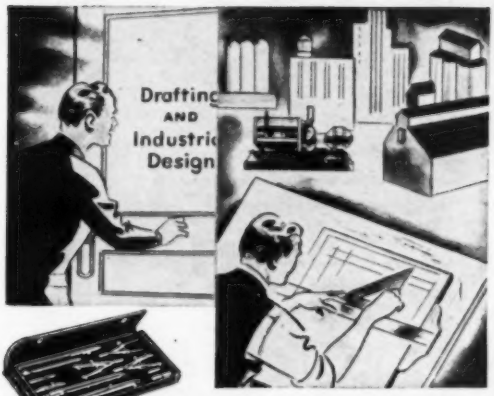

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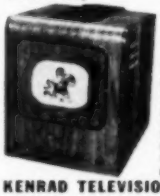

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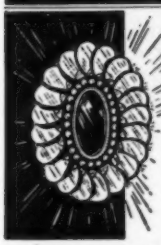

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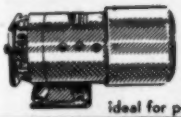

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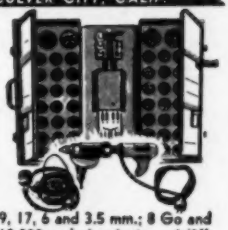

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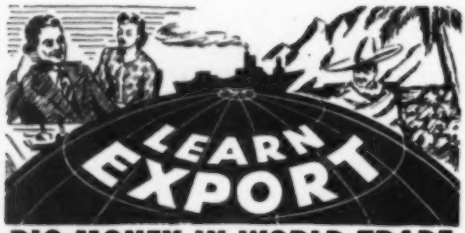

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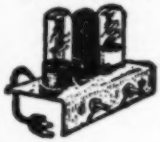

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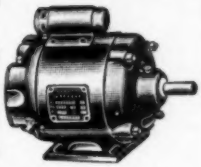

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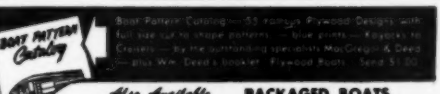

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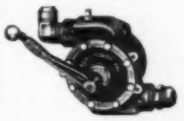

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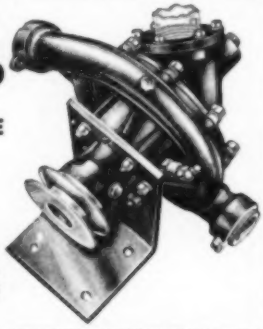

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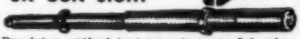

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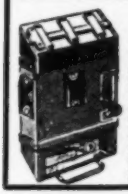

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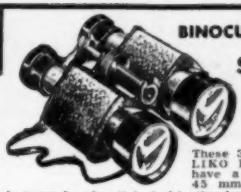

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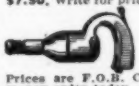

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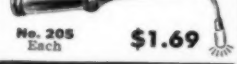

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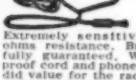

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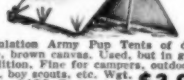

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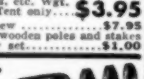

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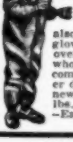

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FREE Catalog—Motors, welders, welding supplies, generators, fencers, electric mowers, freezers, other electrical items. LeJay Company, Minneapolis, Minn.

APPLIANCE Servicemen: Construct your signalling Iron Tester with Pyrion's thermo-electric relays which "sounds off" when proper adjustment temperature reached. Also prevents iron overheating if forgotten! Automatic. Absolutely no attention required. Price $6.25. Other parts available anywhere for less than $2.00. Pyrion Controls, 2215 Moore Ave., Anniston, Alabama.

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LAMP parts, electrical repair parts, wiring supplies. New wholesale catalog—10c. Gearon Company, 6405H North Oakley, Chicago.

AMAZING New pencilator. It gives you ohm's law. Wire sizes and amperes to 60 h.p. a.c.-d.c. and 3 phase current. A guaranteed mechanical pencil for only $1.50. H. E. Zarek Co., Dept. 1, 317 W. Palm St., Compton, Calif.

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ELECTRIC Pencil: Engraves all metals. $1.00 Postpaid. Beyer Mfg., 229-C, Uniontown, Pa.

AMAZING Communication Unit! Remote controlled to send messages house to barn to shop etc. Communicate with Dad working in the garage or Junior in the attic. Contains two identical set-ups with buzzers —lights—remote control transformers and dial with codes. Operates on regular house current ready to operate—simple to connect —Unlimited uses. Only $14.95—Three sets for $40. "Amazing Bachman's." 25 Herman Street, Rochester 5, N. Y.

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HEAVY-Duty, 110/220v A.C. arc welders, R.E.A. approved outfits. Williams Company, Box 4100, Portland 8, Oregon.

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FURNACES, conversions, gas oil, L.P. Easily sold. Write for literature. Thuman Equipment, 1225 Fifth Avenue, St. Joseph, Mo.

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See display ad page 71; Boat Patterns and Kits. Marine Mart, Buffalo 7A, N. Y.

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ART movies 8-16mm. Send dime for list and strip. Glamour Films, Box 1844, Bridgeport, Conn.

WE Buy, Sell, Rent, Exchange Home Movies. Details for dime. Midland, Box 429, Oak Park 3, Ill.

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137 MONEY-making plans, also formulas for salable products. Descriptive booklet free. Elite Co., 220-A Grand St., N. Y.

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400 MONEY making plans, Ideas, Formulas, Schemes, Tips. Folio Free. Formico Press, Box 572, Dayton, Ohio.

106 PLASTICS

PLASTIC—Sheets, Rods, Tubes, etc. Free List. Plastic Supply Co., 2618 St. Louis Avenue, St. Louis 6, Mo.

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PLEXIGLAS, Masked sheets, 12"x12" 1/16" $1.00, ⅛" $1.25, 3/16" $1.55, ¼" $1.85. Include 10% postage. Internal carvings, drills, dyes. Luminous Powders, rods, tubings, cements. Jewelry findings. Free catalog. Craft Plastics, Somerville, N. J.

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"PLASTICS—Sheets, rods, tubes, all colors; dyes, supplies; findings. Illustrated fabricating manual, prices, 10c. Lucite sample, 35c. Gem-O'-Lite, Box 686O, North Hollywood, Calif."

VALUABLE publication "How and Where to Sell Your Molded Plastic and Plaster Casts Profitably," only $1.00. Postal brings free details. Banks, 6635-16 N. Ave., Kenosha, Wisc.

FABROS Pre-fabricated plastic kits and supplies. Sample kit 50c. Catalog free. Fabros, Box 156, Station F-2, Buffalo 12, New York.

POPULAR SCIENCE OPPORTUNITIES

10 ENTIRELY new ideas, plastic projects. $1.00. Designers Group, Box 363, Pleasantville, N. Jersey.

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SAMPLER contains casting-plastic, instructions, models, molds, materials, everything for casting several small, salable novelties. Only $2.00. Circular free. Artcraft, 2917 Michigan, Kansas City 3, Mo.

33 CHEMICALS AND APPARATUS

CHEMICALS-Lab. Supplies New Catalog 10c. Mel-Glo Chemical Co., 258 Fourth Avenue, Brooklyn 15, N. Y.

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FREE catalog: Chemistry, Mineralogy, Biology, Physics. Tracey Laboratories, Evanston, Illinois.

LABORATORY Supplies, Chemicals, Glassware, etc. low prices. Large catalog 15c Microscopic Stain Catalogue 20c. Both for 25c. National Scientific Company, Established 1908, 2204 W. North Ave., Chicago 47, Illinois.

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CHEMICALS, ounce quantities, apparatus, catalog 10c. Fleischer's Laboratories, Everett 49, Mass.

CHEMICALS — Inorganic - Organic, all quantities, Laboratory equipment, all types. Send 10c for catalog. Met & Co., 160 Hillside Avenue, Nutley, N. J.

68 HELP WANTED

"Alaska — The Last Frontier" offers thousands of excellent opportunities. $1.00 brings government map and copyrighted report with authentic listings in fishing, mining, fur farming, prospecting, aviation, construction, homestead lands. Alaska Opportunities, P. O. Box 883, Dept. PS, Hollywood 28, Calif.

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GOOD Paying Business Silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. G, Decatur, Illinois.

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AGENTS. Sell finest Food Products direct to homes. Successfully sold for 25 years. Big profits. Powerful combination sale plans make sales easy. Permanent repeat business. Samples furnished. Live territories open to Distributors. Mother Hubbard Products Co., 4139 Grand, Dept. PS, Chicago.

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SCHOOL Seniors—Earn 40% commission selling classmates America's most beautiful Graduation Name Cards. Largest selection. Outsells all others. Send for free sample kit. Printcraft, 1425 E. Elm St., Scranton 5, Penna.

MAKE More Money selling personal initialed individualized belts, buckles, cap badges, tie holders, 2000 emblems to choose. Big profits, whole or part time. Write today special outfit offer. Hookfast Specialties, Box 1425, Dept. 7, Providence, R. I.

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ABSOLUTELY Free! Big package actual sample fabrics and style presentation of dresses, lingerie, hosiery, etc. Take orders. Commissions big. Send no money. Melville Co., Dept. 4572, Cincinnati 3, Ohio.

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WOULD you pay 3%—first $350 made? Color-illustrated book "505 Odd Successful Enterprises" free! Proven! Work at home, office. Expect something odd! Pacific-6, Oceanside, California.

BE first. Get free details. Earn big money at home. Spare time. Easy, pleasant, exciting, unlimited. 1930 Adoline, Fresno, California.

FREE! Big box actual full size packages foods, groceries, home needs, sent fob factory. Try them at home and show friends. World beating money making opportunity. Write Zanol, Richmond St., Dept. 6091-B, Cincinnati 3, Ohio.

A DRESS yours with every 3 you order for yourself and family. Amazing new bonus plan. Everything Free. Harford Frock, Dept. H-9129, Cincinnati, Ohio.

EARN Big Money Fast! Sell finest-quality advertising work uniforms to garages, factories, filling stations, etc. Free selling kit. Topps, Dept. PS-248, Rochester, Ind.

EARN Big Money. 21 Sunshine Everyday Cards for $1, with beautiful floral lined envelopes. Sensational value. Take orders galore. Costs 50c. Sells $1. Also 1948 Sunshine notes, birthday monogram stationery 50 for $1. Gift wraps, samples on approval. Write today. Sunshine Art, 115 Fulton St., Dept. PS-2, New York City.

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BIG profit. Quick sales. Automatic adding machine sells for $21.50. Your profit $10.00. Write for selling plan. Allied, 2518 W. Montrose, Dept. P, Chicago 18, Ill.

AT last! Something new and sensational in Everyday Cards. New, gorgeous satin and velour designs. Get orders fast. Big profits. Imprinted stationery, 14 assortments for year 'round occasions, retail 60c to $1. Get samples on approval. Puro Co., 2801 Locust, Dept. 841-A, St. Louis 3, Mo.

SELL advertising booklets, service stations, garages, free literature. Ruberts, Carthage, Ill.

AMAZING new zipper shoe sells on sight. Big cash profits for salesmen. Leads line 200 splendid styles. Territory open. Get Free sample outfit. Write Victor Thomas, Dept. V-26, Chippewa Falls, Wis.

BUILD, enjoy own local shoe business. Sell amazing, new patented Miracle Cushion Shoes. Complete line, entire family. No investment, experience unnecessary. Free samples to producers. Free outfit. Paragon Shoes, 728 Columbus, Boston.

NEW "Sponge" Wall Cleaner. Erases dirt like magic. Wallpaper, painted walls, ceilings. Saves redecorating. Lightning seller. Samples sent on trial. Kristee 118, Akron, Ohio.

SILVER cleaning, plating, polishing liquid (NuSilver). Apply with cloth. Renews silverplated ware, articles, pieces. Silverplates brass, copper, bronze. Female, male, selling representatives wanted. Part, full, time. NuProcess Products, Aurora, Illinois.

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MAKE extra money handling magazine orders in your community! Build your own business. Helps furnished. Big demand. Wholesale catalog sent free. Write today. McGregor Magazine Agency, Dept. 13, Mount Morris, Illinois.

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SCHOOL Seniors: Sell classmates superb Craftcards for super profits. Write Craftcards, Box 235(AH), Pittsburgh 30, Pennsylvania.

SCHOOL Seniors!!! Your postal will bring our wonder, Kwick-Sell catalog of popular graduation name cards. Biggest profits$!!! Only firm giving free souvenir chest and card case. Don't miss out! Hurry that postal!!! Craftcards, Pittsburgh 30, Pennsylvania.

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EARN money quickly, easily, pleasantly, showing greeting cards, stationery, wrappings. No experience needed. Up to 100% profit. Send today for everyday assortment on approval. Free personal stationery folder. Thomas Terry Studios, 200 Union Avenue, Westfield, Mass.

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SELL New—used clothing from home, auto, store. Men's suits $1.17. Leather jackets 85c. Overcoats 62c. Dresses 17c. Ladies' coats 38c. Other bargains. Catalog free. S & N, 565 A, Roosevelt, Chicago.

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90c PROFIT each $1 sale! Sell real mothproofing solution. Employ agents. Experience unnecessary—we tell how. Kinford, Wayne 4, Penna.

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$3 FIRE Extinguisher sells wholesale or direct. "Fire-Killer", 101 Franklin, Syracuse 1, New York.

QUICK extra cash. Sell value plus greeting cards. New 1948 line, 30 boxes retailing 60c to $1.00 each. "Flower-of-Month" and initial stationery, first name imprinted remembrance notes. Profits to 100%. Extra bonus. Special offer. Write today for feature all-occasion samples on approval and free name imprinted, floral stationery sample portfolios. Elmira Greeting Card Co., M-43, Elmira, N. Y.

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EXCITING DETAILS, shows "how" you make big profits with our fast-selling new lines! Plastic tablecloths, aprons; Personalized, cotton pillow cases, many other sales-appealing items, novelties! Hurry! Royalty, Box 748-D, Passaic, N. J.

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START Your own business on our capital. Always your own boss. Hundreds average $6,000 to $25,000 annual sales year after year. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world-wide industry. Write Rawleigh's, Dept. B-U-PSC, Freeport, Ill.

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39 CONTESTS

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31 CHALK TALK STUNTS

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RECONDITIONED Typewriters, Printing Devices, Office Appliances Supplies Dixiegraph. King. N.C.

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"PRINTOMATIC" Selffeeding Post Card Stencil Printing Duplicators $9.50 Up. Office Size Duplicators, Speedoprints, Hilcos, Excellographs $33.41 Up. Literature Free. Pittsburgh Typewriter Supply. 336 WE Fourth Ave., Pittsburgh 22, Pa.

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If You Sell A Product or Service To Men, Use This Easy Means To Get More Sales

CLASSIFIED ADVERTISING ORDER

Popular Science Monthly • 353 Fourth Avenue • New York

Please insert the ad below in your.....issue.

Heading.....

Enclosed is $..... Word Count.....

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.....

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EACH WORD IN NAME AND ADDRESS MUST BE COUNTED AS A WORD

Name.....

Address.....City & State.....

To be inserted in the April issue, this order must reach us by Feb. 26th

"OWN a Business" Coupon

DURACLEAN CO.
Division of HOME SERVICE CO.
18-2 CT Deerfield, Illinois

With no obligation to me, send booklet and letter giving full details. Tell me how I may OWN a growing business of my own built upon satisfied customers.

Name.....

Address.....

City.....State.....

Are You The Man?

If you are dependable, honest and willing to work to own a large-profit, lifetime business and become financially independent, we invite you to mail the above coupon for full details. We are now enlarging this 17-year-old, nation-wide chain of **individually-owned** CERTIFIED Service businesses. We'll establish you in YOUR OWN business and help finance you. You use successful methods of established **Duraclean** dealers. This is a sound, steady, lifetime business. Dealer gross profits (above materials and labor) are up to $20 for a day's service on **EACH** of his service men. **Easy to learn . . quickly established.**

Revive, Clean and Protect Upholstery and Rugs

Duracleaning restores the natural fibre lubrication of wool and other animal fibers. Resiliency returns to the pile. It rises again. Brilliant colors revive. Results in many instances are almost unbelievable.

Duraclean banishes the need of cleaning upholstery, rugs and carpeting by harsh machine scrubbing and soaking. It eliminates harmful Solvents and strong soaps.

The aerated foam, created by the **patented** electric Foamovator, cleans by ABSORPTION—not by scrubbing. Dirt, grease and many unsightly spots vanish. **Duraclean** is recommended nationally by America's foremost furniture and department stores.

Duraproof Immunizes against moths, beetles

The patent protected **Duraproof** service not only kills moths and carpet-beetles but is WARRANTED to make fabrics **non-eatable** to both. The U. S. Government says, "**Moths are present in practically every household . . . No section of the country seems free from such infestations.**" Damage to household goods and wearing apparel is greater from moths than from fire. **Duraproof** DEFINITELY PROTECTS rugs, carpets, upholstery, furs, clothing, blankets, piano-felts, auto interiors. Protects against mildew too.

Dealer Comments:

R. Kimbrough: "Finished First White House of Confederacy and am to Duraclean the Governor's Mansion."

P. Wilson: "My business comes from recommendations of satisfied customers."

O. D. Heffelbower: "People who have seen the work have expressed amazement."

Q. Corbett (Canada): "Several hundred dollars in jobs lined up from canvassing."

S. Edsall: "Have 5 women's clubs interested in the work."

H. T. Satterfield: "We Duracleaned a chair for the largest department store and got an order for 60 to 75 chairs, couches and davenports."

E. Schalchlin: "Have on hand 5 orders totaling over $500.00 . . obtained from recommendations of customers."

F. B. Jones: "Your offer is the best and most amazing I've ever had."

No Shop Needed — EASY to Learn

No overhead expense. Both services may be rendered in homes, offices, hotels, theaters, institutions, etc., by your service men. Auto dealers have upholstery **Duracleaned** in used cars. Foamovator converts to carrying case. Some establish shops or an office—others operate from their homes.

Start Part or Full Time

No experience needed. We show you 18 ways to get customers. Almost **every building** in your territory houses a potential customer. There is a waiting market in small and large towns alike.

Duraclean and Duraproof are year-around services for which there is always a constant need. Free booklet and our first letter explains everything. Just mail coupon.

Repeat and Voluntary Orders

Demonstrations win new customers. Men in this business find REPEAT and VOLUNTARY orders become a major source of income. Customers are not merely satisfied—many are enthused at results and tell friends and neighbors.

Double Profits

You enjoy large profits on both materials and labor, after paying service-men and salesmen. At the start, you may want to render **Duraclean** service yourself. You have national prestige and cooperation of a national organization interested in YOUR success.

OWN a Growing BUSINESS

FREE Booklet

Our first letter and 16 page illustrated booklet will explain everything — these modern urgently needed services, the waiting market, how business grows, your large profits, easy terms and protected territory.

Send for It— Mail Coupon

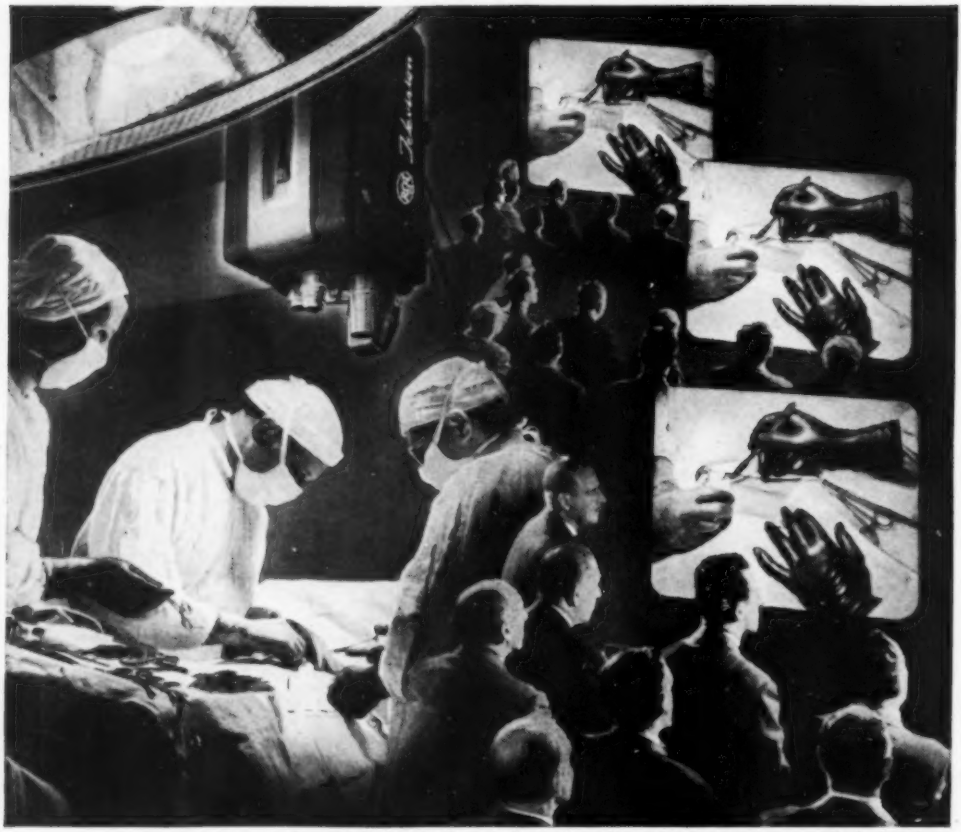
EASY TERMS:

A moderate payment establishes **your own** business—pay balance from profits. We furnish electric machines, folders, store-cards, introduction slips, sales portfolio, demonstrators and enough materials to return your TOTAL investment. You can have your business operating **in a very few days.** Just mail the coupon. No obligation.

Copyright 1947 by

DURACLEAN CO, 18-2 CT, Deerfield, Illinois

Mail Coupon TODAY—While Territory Is Open!



Successful telecasts of surgical operations show value of television to medical education.

"Step up beside the surgeon—and watch"

Not long ago, a radio beam flashed across the New York sky—and "carried" 7000 surgeons into an operating room...

Impossible? It was done by television, when RCA demonstrated—to a congress of surgeons—how effective this medium can be in teaching surgery.

In a New York hospital, above an operating table, a supersensitive RCA Image Orthicon television camera televised a series of operations. Lighting was normal. Images were transmitted on a narrow, line-of-sight beam . . . As the pictures were seen the operating surgeons explained their techniques . . .

The beam was picked up at a midtown hotel—carried to RCA Victor television receivers. And on the video screens, visiting surgeons followed each step of surgical procedure. Action was sharp and clear. Each surgeon was as "close-up" as if he were actually beside the operating table.

Said a prominent surgeon: "Television as a way of teaching surgery surpasses anything we have ever had . . . I never imagined it could be so effective until I actually saw it . . ."

Use of television in many fields—and surgical education is only one—grows from advanced scientific thinking at RCA Laboratories. Progressive research is part of every instrument bearing the names RCA or RCA Victor.

When in Radio City, New York, be sure to see the radio and electronic wonders at RCA Exhibition Hall, 36 West 49th Street. Free admission. *Radio Corporation of America, RCA Building, Radio City, New York 20, N.Y.*

RADIO CORPORATION of AMERICA

PS
The Voice of Science

The First Scientist Was a Good Workman

NOBODY knows his name or his color or the shape of his head. But everybody knows what he did: he used his head to save his back.

Perhaps he was alone and had hurt his back. Maybe there was some special urgency, like a strong smell of tiger. There must have been some good reason why he tried thinking. Because thinking was harder than sweating. It still is.

Anyway, there he was with a rock and a reason and an idea. Maybe he got the idea originally when a round stick rolled under his foot. The important thing is that he dared to try something brand new. That's what made him a scientist. And he was a good workman because he didn't shirk the hard part: whacking and rubbing the bumps off the log to make it roll.

Every scientist, whether he measures the power of a fly's leg or fits something he can't see into figures, is always a good workman. And every good workman is a part-time scientist whenever he thinks his way around a tough nut instead of just batting it one.

Next time you turn a corner in a car or hear a train rumble through, remember the gent in the fur pants who dreamed up the roller under the rock. He did a lot for you: he invented the wheel, brother!

Perry Gilkey

he's going places... he's got P.A.*

P.A.* means Pipe Appeal

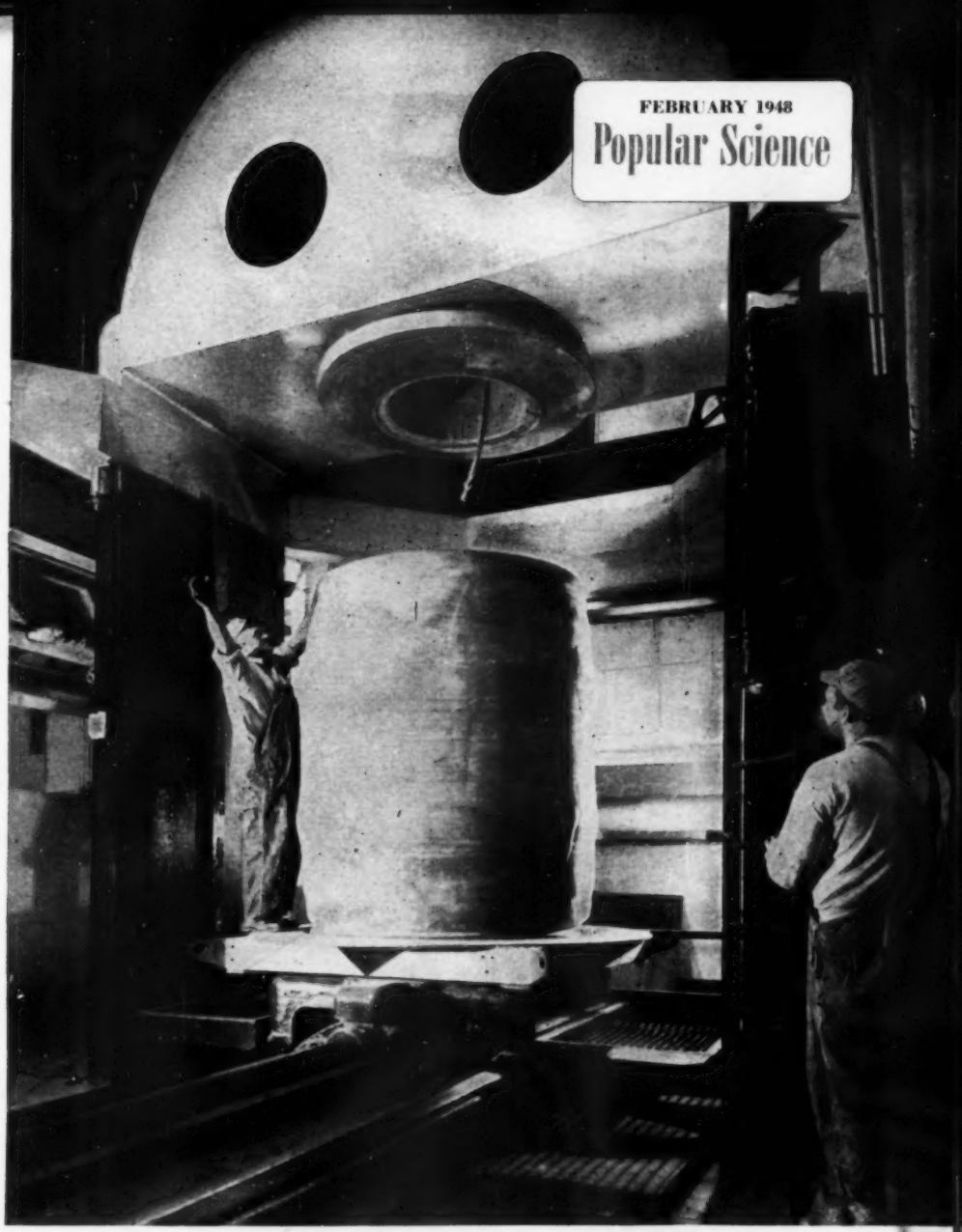
Pipe Appeal is that distinctly masculine appearance of the man who smokes a pipe! Thousands of men fill their pipes with Prince Albert Smoking Tobacco!

means Prince Albert

R. J. Reynolds Tob. Co., Winston-Salem, N. C.

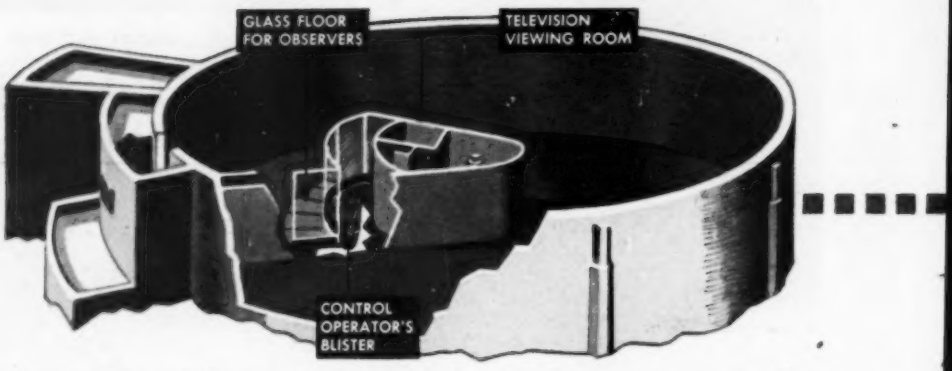
• Prince Albert is the largest-selling pipe tobacco in America. Its choice tobacco is rich tasting ... mild and easy on the tongue. P. A. is crimp cut—specially treated to insure against tongue bite. Try Prince Albert!

THE NATIONAL JOY SMOKE

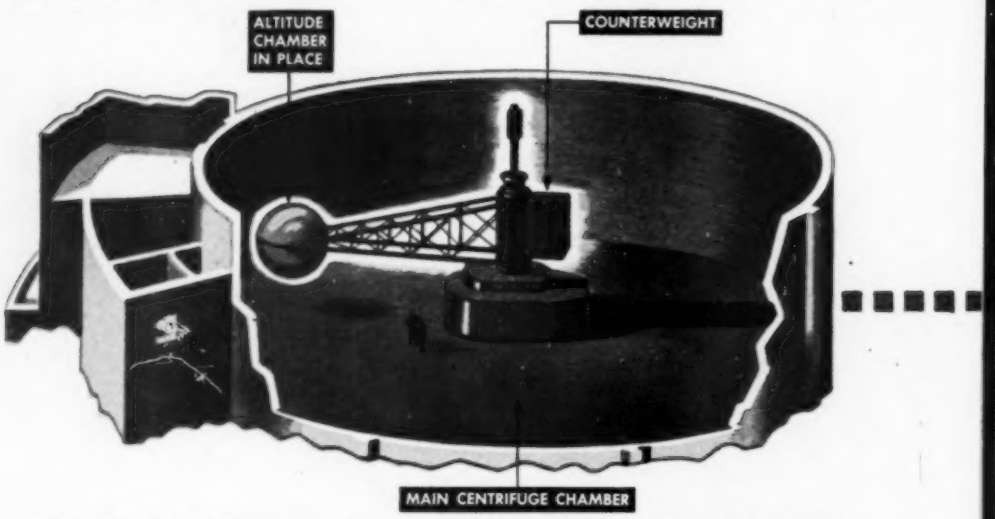


Ready for the Big Squeeze . . .

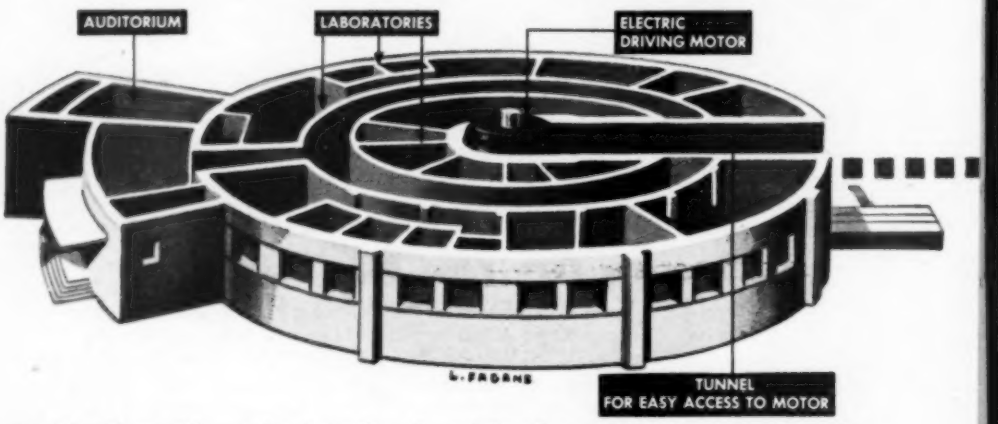
This hollow mass of rubber is on the receiving end of a 69-foot-high hydraulic ramrod. When pressure is put on, the rubber will bulge out into the doughnut shape of a giant tire for earth-moving tractors used in building highways and airports. These massive tires have 140 times as much rubber as those of the average passenger car, and weigh more than most automobiles. Hose dangling from top of this Firestone press connects with a "curing bag" used to shape tire.



Observation facilities, television receiver, instruments, and control room are on top floor.



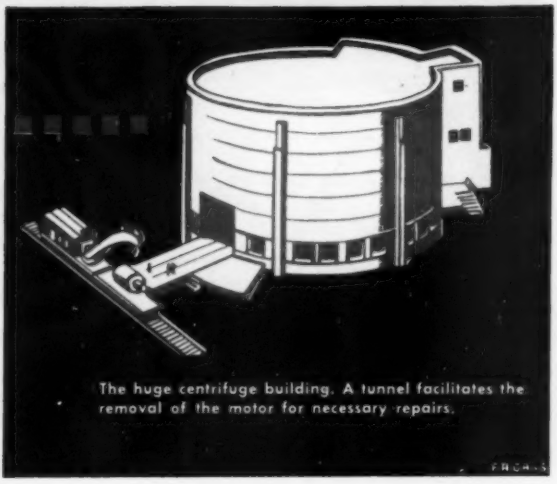
In main chamber is centrifuge with 50-ft. steel arm rotated by 145-ton, 4,000-hp. motor.



Lower floor houses laboratories that will analyze, help solve problems of supersonic flight.

On the television screen, the doctor in charge gets a continuous view of the subject during a test.

A motor-driven, triple-gimbal mounting allows the cockpit to be adjusted to any desired position.



The huge centrifuge building. A tunnel facilitates the removal of the motor for necessary repairs.

New Guns for Human Bullets

By George H. Waltz, Jr.

Drawings by Lester Fagans

TAKING an all-out ride in the Navy's newest laboratory "gun" will be like sitting astride a standard aircraft rocket as it starts toward its target. This "gun" is a human centrifuge to end all centrifuges—a giant, high-speed merry-go-round capable of making a man feel like a bullet being shot from a rifle.

Scientists will use the machine to learn a good many new facts about the physiological and psychological effects of high speeds and sudden changes in speed. They will do it by subjecting pilots to tremendous forces of acceleration and deceleration. As pilots and airplane manufacturers strive to bore deeper and deeper into the "no man's land" of supersonic and super-supersonic flight, new problems are arising. It is not now so much a question of whether the plane will hold together as: "Will the pilot?"

What happens inside the human body when it is suddenly accelerated or decelerated? What happens if, while shooting through the air at 1,000 m.p.h., the direction is quickly changed as in a pull-out from a dive or in a sharp turn? What effects does high altitude, with its reduced oxygen, have on a pilot's ability to withstand those forces? How will airplane instruments and equipment stand up?

It is to help dig out the answers to those questions and many other supersonic puzzlers that the Special Devices Center of the Office of Naval Research is building this $2,500,000 centrifuge—the world's biggest and best equipped. It will be large enough

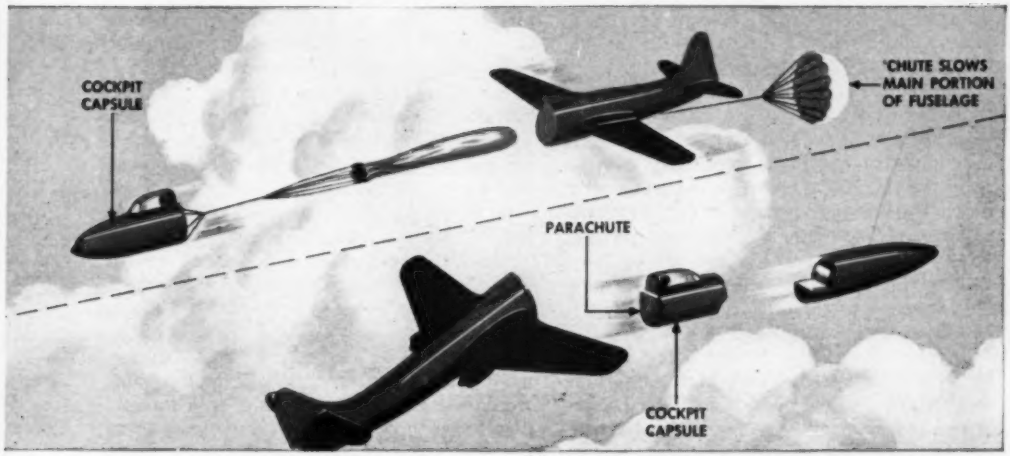
In this pilot-escape device, the entire cockpit is catapulted out of plane. When speed of cockpit has been reduced, a large parachute opens and lowers pilot compartment to the earth.

and spin fast enough to subject anything placed in its test cockpit to acceleration rates as high as 10 G a second (the normal force of gravity is 1 G, or the normal weight of a person or object). It will be possible to develop accelerations as high as 40 G, just about twice the maximum G force developed by any existing centrifuge. Such high G shots are not contemplated, however, for tests on human beings.

Housed in a smoothly modern, 130-foot-diameter, circular building near Johnsville, Pa., the new G-gun will have a 50-foot steel arm whirled by a 145-ton, 4,000-hp. electric motor. Mounted at the outer end in multiple gimbals like the flywheel of a toy gyroscope, will be the test cockpit or gondola.

A decompression chamber, a hollow sphere that clamps over the entire gimbal mounting with its cockpit, has been designed. With the chamber in place, air will be pumped out until the test subject is not only exposed to the G-forces of acceleration and deceleration, but to altitude conditions as high as 60,000 feet.

The two-way gimbal system (a last-minute engineering change from the original triple-gimbal design illustrated on p. 99) is one of the most important features of the new centrifuge. Electric motors at the axes of the gimbal mountings will automatically



Two versions of Navy's design for come-apart plane that enables pilot to escape at high speeds.

keep the test cockpit in such a position as to eliminate most of the unwanted effects of acceleration, regardless of the speed of rotation.

Seated in his observation blister hung from the ceiling, the centrifuge operator will have full control of the speed and gyrations of the test cockpit. This is made possible by the motor-operated gimbal mounting. An electronic brain will control the speed of the main motor and its giant arm with hairline accuracy. All the operator will have to do is set the controls for the accelerations he desires prior to a test run, and the electronic circuit will take care of the rest. So quick and smooth will be the action of the drive motor that the test cockpit can be shot from a standstill to its top speed of 174 m.p.h., (40 Gs) in less than seven seconds!

Television Tells Story

Observers will be able to watch the man being tested at all times through the eye of a television camera mounted in the cockpit. Automatic recordings also will be made of such things as the test subject's blood pressure, his pulse, the amount of oxygen in his blood, and his brain waves. Although the current design does not include the high-speed X-ray motion picture camera indicated in the artist's drawing on p. 99, provision has been made for its future installation; this would give observers a running record of what happens to the man's insides.

The building housing the centrifuge will be a complete aeromedical experimental station. On the main floor, directly under the centrifuge, will be a darkroom, a surgery, and physiological, clinical, and biochemical laboratories. From these laboratories may come the answers that will help beat the problems of supersonic flight.

Getting the Pilot Out

One of the problems plaguing aeromedical experts as well as supersonic plane designers, is that of getting the pilot safely out of one of these high-speed craft should it develop trouble at high altitudes. Here it is a matter of violent G forces in the form of quick deceleration. The pilot must be safely slowed down from the speed of sound to a speed that permits a safe parachute opening and descent.

Until not so long ago, a pilot with a disabled airplane on his hands simply pulled back his cockpit canopy, bailed out over the side, counted 10 to get himself safely clear of the plane, and pulled the rip cord. But when plane speeds increased materially during the war, a powder charge was provided to blow the canopy free and make the pilot's escape easier. Next, with even greater speeds, came the Navy's record-breaking, jet-propelled *Skystreak* with its detachable nose (PS., Mar. '47, p. 93) and the ejectable seat that catapults both seat and pilot out of the cockpit.

In planes flying in the transonic speed zone at high altitudes, however, neither the jettisonable nose nor the ejectable seat would be completely effective. Without some overall protection against both the sudden brick-wall impact of a 700- to 800-m.p.h. slip-

stream, and the lack of sufficient oxygen, a pilot might be badly injured, if not killed, before he could open his parachute.

One answer, Navy engineers feel, is to keep the pilot right where he is, securely strapped and braced in his cockpit, detach the whole as a unit or protective capsule from the rest of the plane, and then slow it down and lower it by means of a modified ribbon-type parachute. A ribbon parachute would be used rather than the conventional full canopy type to ease the cockpit to a slow speed instead of snapping it to a quickly decelerated stop.

In one pilot-escape device being considered by experts at the Navy Material Center in Philadelphia, the pilot of a disabled high-speed aircraft would simply hit a convenient red-knobbed button with his hand. With a loud bang, the plane's entire cockpit—complete with sealed canopy, oxygen supply, and pilot—would be shot up out of the plane. (See illustration on page 100.) Finally, after the speed of the cockpit had been reduced, a large parachute would automatically billow open and lower the cockpit to earth or to a safe altitude where the pilot could bail out and use his own 'chute.

A second design uses a jettisonable nose like the *Skystreak*, but develops the idea further. Its front or nose section also drops off, but instead of being open at the rear and merely providing a quick means of escape or bail-out, it is a closed capsule and has its own automatic parachute. A second automatically released 'chute is attached to the main portion of the fuselage and slows it down, holding it back to prevent a collision with the detached nose.

In a third version of the Navy's escape technique, a button touched by the pilot would fire explosive charges to split the airplane into three separate parts—nose, cockpit, and main fuselage with wings. Once free of the rest of the plane, the cockpit would drift to earth under its own automatically opened 'chute. As with the catapulted cockpit, the pilot could ride it to earth or bail out and use his own 'chute when he reached a safe altitude. END

Big Glass Has a Rival

IN a modest effort to "jump the gun" on the giant 200-inch telescope being installed at Palomar Observatory, Southern California amateur astronomers devised this unique open-air housing for their 21-inch 'scope. Here one of the amateurs is examining the gears of "Palomar Junior." A regular astronomical dome will come later.

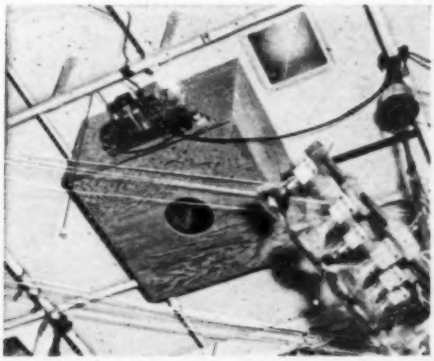
"Pocket ear" radio for receiving cues on television stage evolved from "Man from Mars" (left), and "Happy Hooligan" (center). Girl at right wears new, almost-invisible pocket ear.

Private Radio Cues Tele Shows

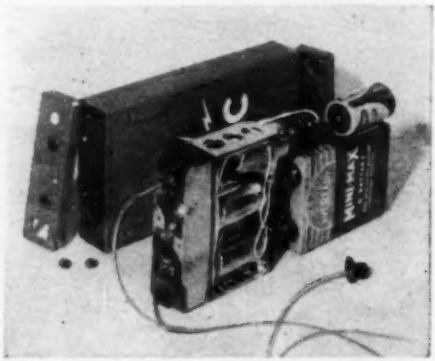
TELEVISION actors and directors now get their cues over their own private radio network. In the National Broadcasting Company's New York station, WNBT, instructions from the stage manager, who sits in a soundproof booth, are broadcast on short wave and received inside the studio on small portable sets called "pocket ears."

The pocket ear, developed by NBC engineers William Hotine and Lou Hathaway, is the latest in a series of lightweight radios devised to replace the old system of relaying instructions—a telephone headset connected to the control booth by a long wire. The new device is so inconspicuous it can be strapped under clothing and worn by actors before the television camera.

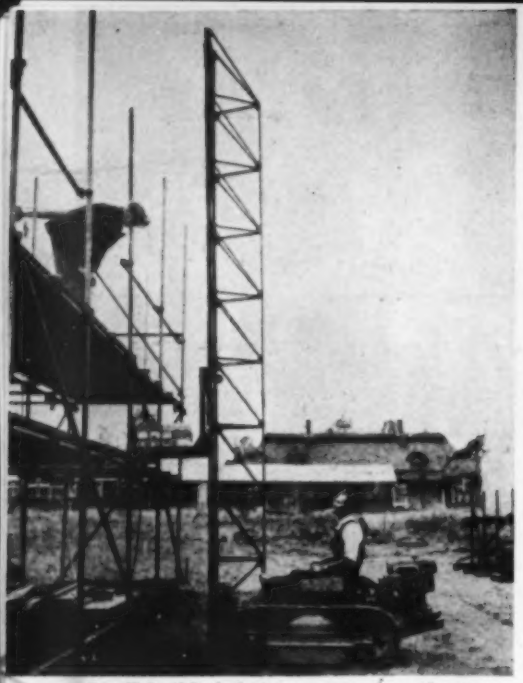
WNBT television director gets instructions from control booth over receiver strapped around his waist. Before advent of radio system, he had to drag long telephone wire behind him.



Transmitter for pocket ears is a small set on side of a wooden box fastened to studio ceiling. The box houses a public-address-system loudspeaker for issuing instructions during rehearsals.



Disassembled view shows tubes and batteries of pocket ear. Instead of usual earphone, it uses an ear plug. Sound travels from receiver to plug over air-filled channel in a hollow plastic tube.



Small builder's hoist consists of an aluminum-alloy mast and winch. In a few minutes, two men can attach it to the little six-horsepower tractor, developed from a farm tractor.

This barrow for carrying bricks is self-clamping. In the photograph above, the laborer is operating a lever that enables him to pick up a stack of 40 bricks at one time.

New Machines, Methods Help Rebuild Britain

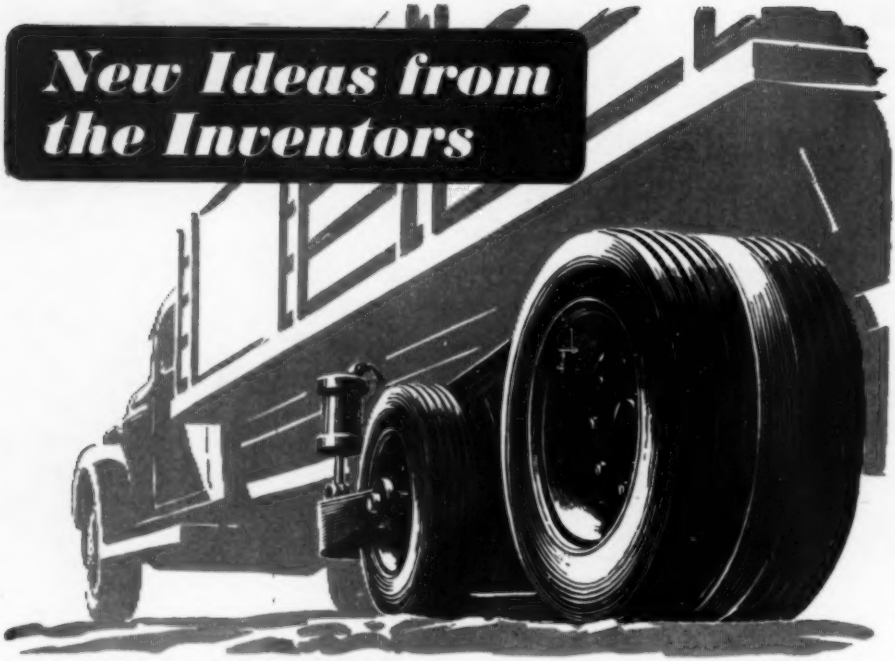
The multipurpose tractor, shown at top of page with hoist, is used here with other attachments—a bottom-discharge concrete skip at one end, a small 'dozer blade at the other.

This general purpose transport barrow for builders has a seven-cubic-foot capacity for such loads as concrete, bricks, or dirt. The little carrier is powered by a small gasoline engine and controlled by the operator as he walks with it. Above, it is being tipped to discharge its load. To reverse the barrow, the whole power unit is rotated about its axis.

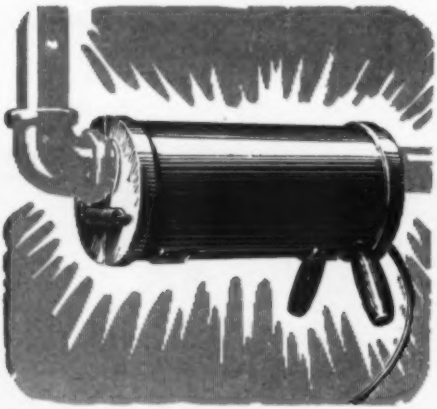
FACED with the rebuilding of their blitzed cities, the British are developing new machines and products to speed construction. Here are some of the latest from the Ministry of Works field-test unit. Several of the machines designed to end laborious hand pulling and lifting look as though they might prove useful on this side of the Atlantic. Whether they would be acceptable to U. S. building-trades workers, fiercely defensive of their traditional working rules and methods, is, however, yet to be seen.

Here's how a slate roof can be laid without putting on each slate separately. Whole sections can be preassembled, either at the site or beforehand, and fastened to the roof as a unit.

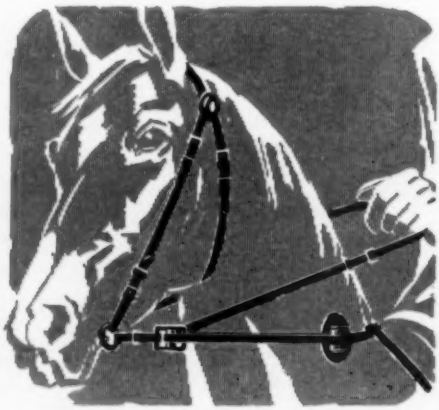
New Ideas from the Inventors



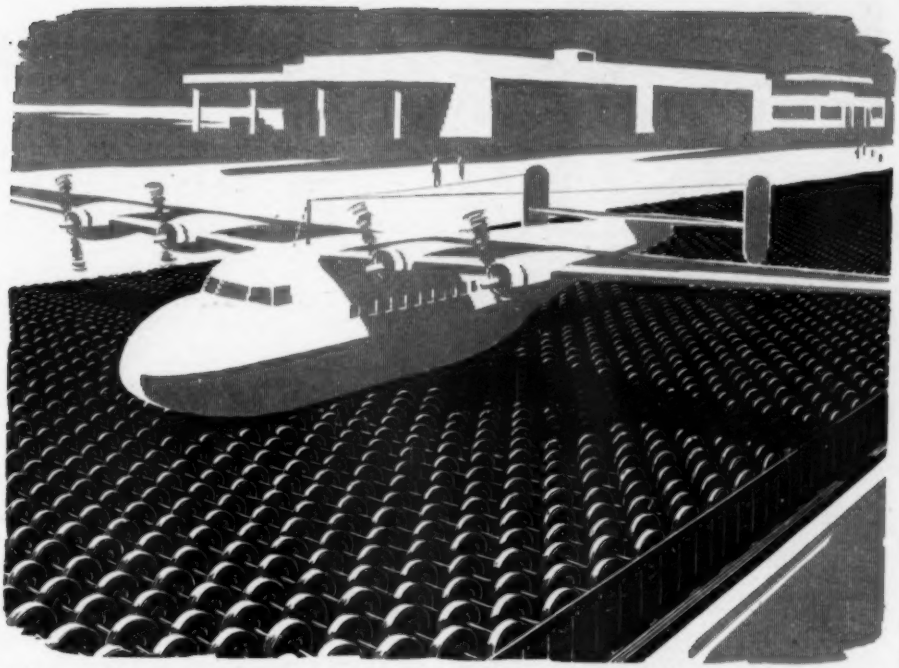
Extra Wheels Prevent Miring. A pair of retractable wheels has been invented by Kibbey W. Couse, of Newark, N. J., to help keep heavy trucks from bogging down in mud. Belt-driven by the rear wheels, the smaller auxiliary wheels can be lowered when needed, making the belt touch the ground. This increases traction.



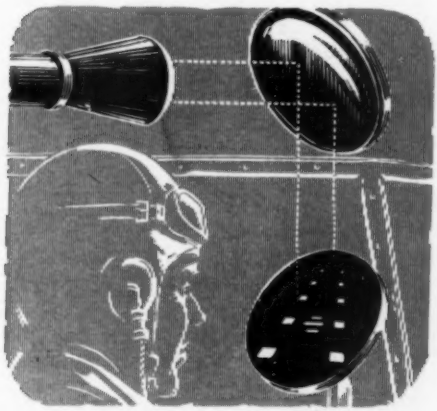
Hand Heater Thaws Pipes. A far cry from the plumber's blowtorch, this portable household heater is designed to free frozen water pipes in only a few minutes. Clamping around a pipe like a large, elongated claw, it surrounds it with electrical heating coils. The device was invented by Francis L. Taulman, of Tulsa, Okla.



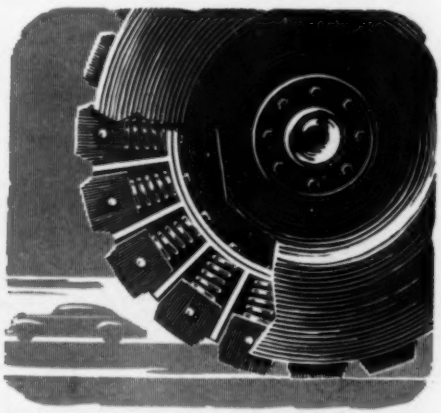
Pulleys Help Guide Horse. An eager or unruly horse would be no problem with the novel bridle patented by John D. Telford, of Palmerston North, New Zealand. Instead of pulling directly on the bit, the reins run through pulleys attached to it. The mechanical advantage thus secured gives the rider far greater control.



Planes Need No Wheels. Airplanes should keep their wheels on the ground, believes Samuel S. Knox, of Long Beach, Calif. He has patented a landing strip formed of pneumatic-tired wheels, which could be powered to speed take-offs and braked to shorten landing rolls. It would free the plane of landing-gear weight.



Helping Pilots Alight. This radio landing aid will let a pilot "see" a fogged-in airport's lights. Invented by E. M. Deloraine and G. J. Lehman, of New York, it picks up radio signals from each light, then throws the image pattern on a semitransparent screen through which the pilot eventually sees the real lights in same pattern.



Airless Tire Saves Flats. Here's a tire you'd never have to change for a flat. Since it requires no air, it can't blow out or puncture. Its surface consists of closely spaced, teethlike treads, each separately spring-seated in the body of the wheel for the necessary bounce. It was invented by Joseph T. Murphy, of Akron, O.

Desert Scenes In Miniature

Only artificial part of the dioramas are clay on wire replicas of the giant saguaro. Here a worker is putting finishing touches on the plant nature didn't supply in diminutive form.

WANT a corner of the desert in your living room? The Knauff family of Tucson, Arizona, will sell you everything but the wind. And the miniatures are true to the colorful beauty of the original, because the sand, rocks, and plants come from the desert.

First step in making these three-dimensional miniatures is the sky and mountain background, painted in delicate pastels. Next a concave foreground is packed with a wet, mudlike mixture that is worked to form roads and natural desert contours. To this base the tiny plants and fragments of colored rock are added, and the whole sprinkled with sand. Oil paints give the final color: dry grass tufts and dull moss become realistic greasewood and cholla; brilliant orange flowers appear on waving ocotillo.

Although started as a hobby some years ago, these unusual pictures are today a thriving business. With a staff of assistants, the Knauffs have turned out more than 50,000 of the desert dioramas.

Photos by Ray Manley from Western Ways

The desert itself supplies the other basic materials out of which its realistic reproductions grow. Here a day's booty—Indian wheat, tassels of date palms, tiny burrs—is sorted.

Making frames like those above from the skeleton of the saguaro, a tall, treelike cactus, started the Knauff family in the business of creating these miniature desert scenes.

In this vivid diorama, snips of desert grass make realistic sage; and tiny burrs, barrel cacti.

After background has been painted in, the concave foreground is packed with a mudlike substance to make the "ground" of the desert scene. Here a palette knife is used to cut a highway.

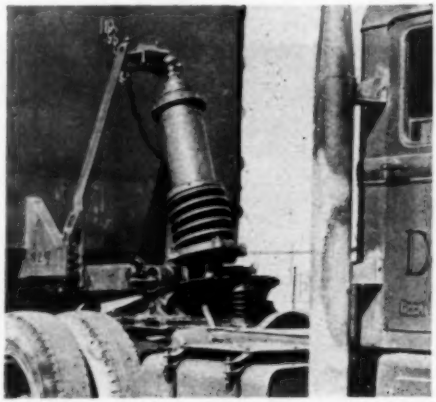
Colored pieces of rock are set into the mixture, and gashes made to hold the bits of trimmed moss and grasses that form the plants. Oil paints add the bright hues of desert growth.

Extended, the seven-sectioned, telescoping dump hoist is 18 feet tall, can lift a 50-ton load.

Multi-Lift Hoist Dumps Faster

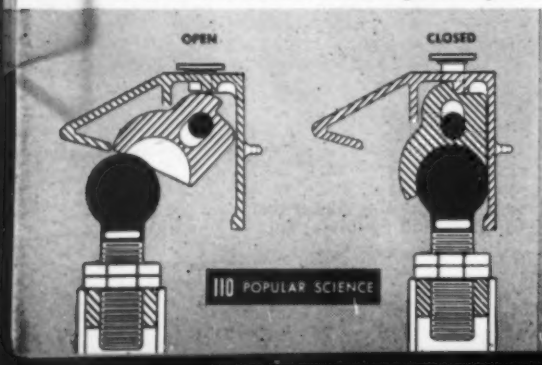
THIS giant Fruehauf trailer truck speeds dumping operations by allowing one truck to handle several trailers. The dump hoist, a telescoping, hydraulic jack, is mounted on the truck instead of the trailer and couples automatically, eliminating separate hoists and hose connections.

To dump a trailer, the truck just backs up to it; one automatic coupling hooks the two together, while another locks the hoist in place. Under 600-p.s.i. pressure, the hoist then upends the trailer box in a matter of seconds. Uncoupling of the trailer is the only manual operation required.



As truck backs up to trailer, a V-slot guides hoist's knobbed head into self-locking coupling at top of trailer's hinged A-frame. Hoist is swivel-mounted for self-alignment with trailer.

As knob engages coupling, a half-socket casting turns inward, as diagramed below, at left. As hoist starts to rise, it is then pushed upward and locked in place. Close-up at right shows hoist locked in trailer's A-frame. Note the close nesting of the retracted hoist sections.



Hercules Hogs Harbor

WITH port facilities dwarfed in the background, this photograph of the Hughes flying boat dramatically frames its massive proportions. Recently flight tested (PS, Dec. '47, p. 92), it is estimated that the 400,000-lb. plywood giant will carry more than 500 people, or a total payload of some 70 tons. Its eight engines develop 24,000 hp.

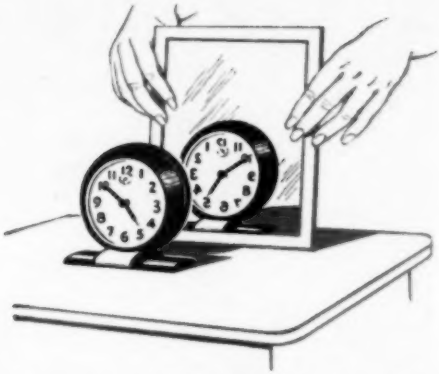
Backing Up the Cargo

HINGED tail of the planned new Curtiss-Wright CW-32 would make possible the rear loading of very long or bulky shipments. Trailer shown in drawing above would permit the handling of the entire cargo for one destination as a single item, cutting delivery time. Freight compartment would hold household furnishings for 21 average rooms.

I'd like to see them make . . .

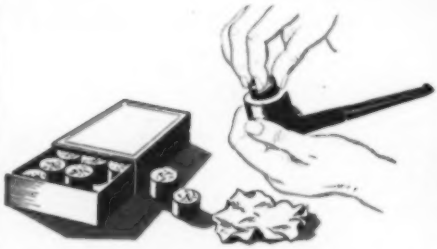
Drawings by Lester Fagans

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? POPULAR SCIENCE will pay $5.00 for every such suggestion that it accepts for publication. Contributions cannot be acknowledged or returned.



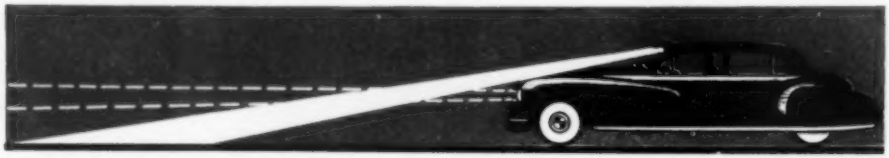
Two-Faced Clocks. On a bedside table between twin beds, such a clock could be read without neck-craning. A gear train would drive the reversed hands. Controls could be put on the rim.—DORIS NELSON.

Weighted Pens. If fountain pens were made with a weighted cap, they'd land harmlessly on that end when accidentally dropped—instead of on the point. Hence, you'd save the expense of a new point.—RALPH HANKE.



Individual Pipe Charges. Little packets of tobacco conforming to the inner dimensions of the average pipe bowl could be carried conveniently and would provide an easy loading method.—EDWARD EHRLICH.

A Power Scouring Brush. It could consist of a rotary wire brush on a stainless-steel flexible shaft running to an electric motor. The unit should be mounted on the wall near the sink.—JIM BENNETT.



Car Headlights Higher. This would help keep oncoming drivers from being blinded. The higher the lamp is placed, the farther ahead it would cast its beam without throwing light directly into the eyes of approaching drivers.—FRED MATHIS.

New Buick Flows from Low to High

First torque shift on the road replaces the usual three speeds forward with an infinite number of gear ratios.

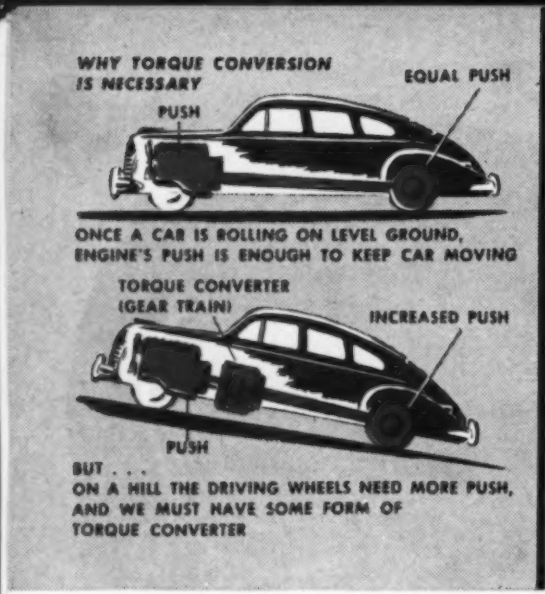
By Devon Francis

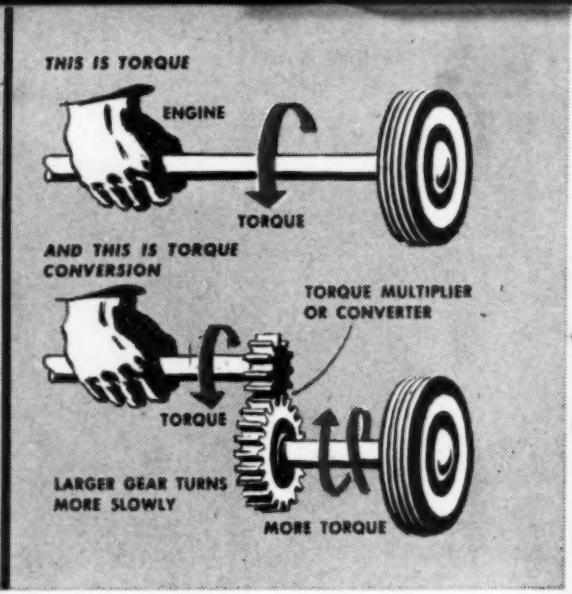
ON HUNDREDS of highways last year U. S. motorists watched a new kind of automobile whiz past them without knowing they were witnessing what promises to be a major revolution in power transmission on wheels.

Late last month the secret was out. Test cars had roamed the Middle West, the South, Rocky Mountain states, and California for months. Outwardly each looked like a 1946 or 1947 job, but tucked between its engine and propeller shaft, in place of transmission gears, was something called a "torque converter."

For passenger cars the torque converter may be the biggest stride in transmissions in a quarter of a century. Every major Detroit manufacturer is experimenting with some version of the idea. But for 1948, the Buick Roadmaster model has stolen a march on the industry.

The torque converter gives to vehicles with internal combustion engines the same kind of smooth power flow produced by steam engines and electric motors. It is to automobiles what the variable-pitch pro-





peller is to airplanes. It gives the motorist literally an *infinite* number of "gear ratios." Tromp on the accelerator from a standing start, and the car moves off as smoothly as though you were releasing the brakes on a hill. Lift your foot, and it feels like a power boat cushioned by the fluid it floats in.

To see how torque conversion works, let's start with how your engine makes the car move. The engine's *power* means its ability to give your car a certain amount of push while making it go at a certain speed. This push is given to a rotary crankshaft, so it is called *torque*. We can increase torque at the expense of speed or speed at the expense of torque. When we shift into low gear for lots of torque—push—and not much speed, we are increasing the engine's leverage on the wheels. This increased leverage is called *torque multiplication*. It's what an ordinary gear shift does.

Dynaflow transmission looks not unlike conventional type when installed in car, but with cooler it weighs almost 50 lb. more. Since it can multiply torque only about 2¼ to 1 as compared to 4 to 1 for low speed of average car, a geared low with ratio better than 4 to 1 is added to the Buick for emergencies. Torque converter uses eight quarts of special oil.

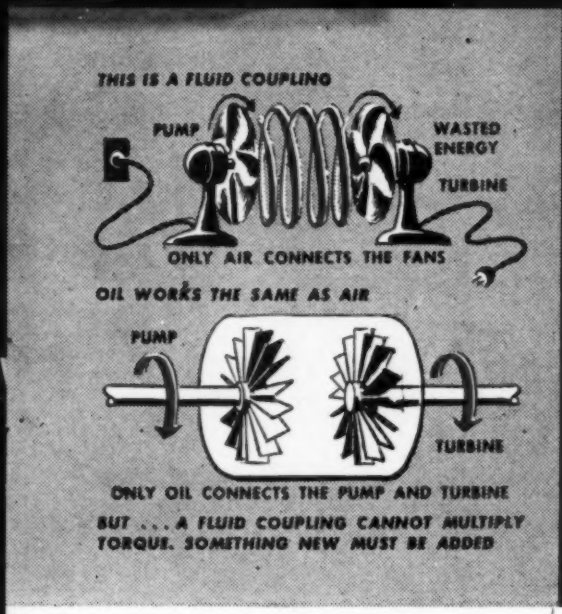
Hydraulic torque conversion means using a fluid to provide the proper ratio of speed and torque. The fluid supplies the proper "gear ratios" in a complete absence of gears. With a torque converter you can say of your gear ratios, as Jimmy Durante might say, "I got a million of 'em."

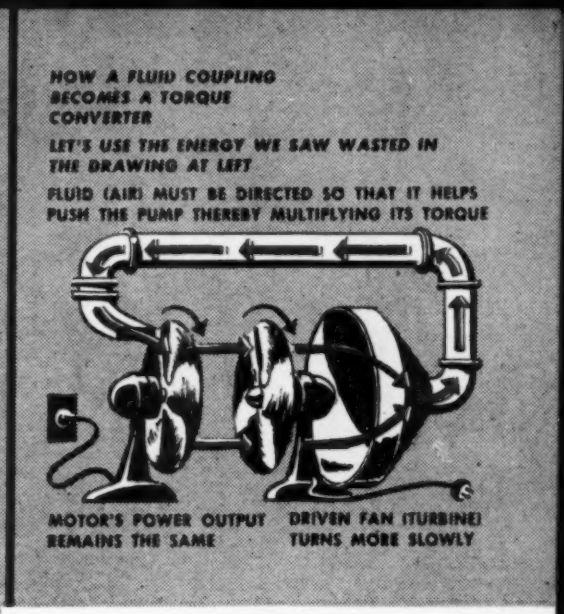
Substitute for Friction Clutch

To get at the nub of hydraulic torque conversion, let's examine the simple fluid coupling also known as the "fluid clutch." It is only a substitute for a friction clutch. Chrysler, Oldsmobile, and some other cars have them.

The fluid coupling consists of a vaned driving member and a vaned driven member working in an oil bath. They work exactly like a couple of electric fans placed face to face with one of them plugged into an electric outlet. One fan blows; the second fan turns with the blast of air from the first fan. *This is a fluid coupling.* It transmits motion without gears.

But mark this point: No matter how ef-





ficient the two fans are, the first can transmit to the second only the amount of torque or twist it has in its shaft. The second fan can't be "geared down" through the fluid coupling to boost the twist.

An automobile's fluid coupling works the same way. It doesn't "gear down"—it doesn't provide torque multiplication. If only a fluid coupling were put between the engine and a car's propeller shaft, it would be like driving from a standing start through all speed ranges in high gear. The fluid coupling has to hitch into a gear train or its equivalent when more "push" at the rear wheels is needed than can be obtained merely by depressing the accelerator pedal.

That these gears can be, and in some cars are, shifted automatically is beside the point. A gear transmission remains a gear transmission. What Buick has done is to replace the gear transmission with a hydraulic torque converter that is at the same time a fluid coupling.

Two Kinds of Oil Flow

Now let's see how these two are combined. Interestingly enough, you can get torque conversion by altering the design of a simple fluid coupling. That's because of the nature of the oil flow inside the coupling. There are two kinds of oil flow, rotary and vortex. In rotary flow the oil swims in a circle with the centrifugal pump of the coupling (or Number One electric fan) and the turbine (or Number Two electric fan). In vortex flow it moves in a spiral.

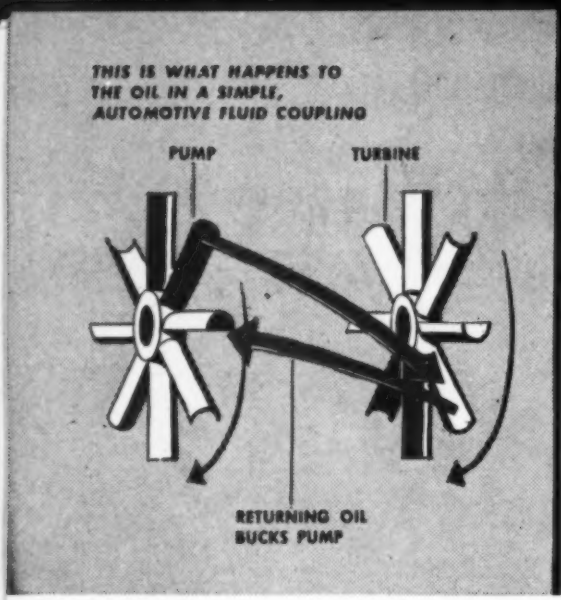
At low rotational speeds of the coupling the oil flows outward from the hub of the pump to its perimeter. There, in vortex flow, curved blades catch it and toss it across to the turbine, as a basketball player would pass the ball to a teammate across the court. At the turbine side other blades catch the oil. The kinetic energy that is imparted to the oil by the pump is transformed into mechanical energy as it hits the turbine. The turbine turns under the impact.

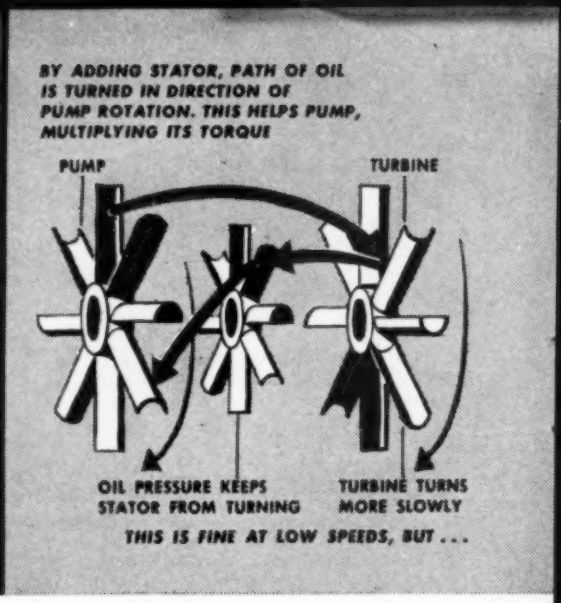
Blades Act as Buckets

Something funny happens right here. The blades of both pump and turbine act somewhat like buckets. To make the fluid coupling work, the buckets on the pump must be concave in the direction of the rotation, while *those on the turbine must be convex.*

Up to now the oil is willing and well-behaved. But suddenly it gets stubborn. It flows from the perimeter of the turbine down to the hub, and there some trouble starts. It still has a lot of kinetic energy, and on account of the curve of the turbine blades it proceeds to spew this energy *against* the blades of the pump. It acquires this reverse English in a caroming action off the turbine blades. The pump conscientiously keeps tossing the ball to the turbine and the turbine keeps spitting in the pump's eye.

Getting torque multiplication from a fluid coupling just means making the oil help





rotation instead of hinder it at low speeds.

This is how it's done: Stationary vanes called stators are interposed between the pump and the turbine. Short and stubby, these stators are snugged into the assembly at the hub, where the oil returns to the pump from the turbine. They catch the oil leaving the turbine, smack it smartly, and send it off in the right direction.

Instead of bucking the pump, the oil boosts its torque.

Let's return to the example of the electric fans. If you grabbed the air as it left the second fan and piped it back to the first fan, and blew it against the blades of that fan to increase its torque, you would have torque conversion. This actually would be more twist at the shaft than the motor would supply by itself. In increasing its twist it would transmit more energy to the air it blew. The air would transmit more torque to the second fan. The second fan would get *torque multiplication*. And the source of this?—the energy in the air that otherwise would be wasted.

Rear Wheels Get Added Push

The same thing occurs in a hydraulic torque converter. The engine flywheel is bolted to the pump and transmits to it the twisting effort of the crankshaft. The oil flow boosts the pump's twisting effort. This boost is transmitted to the turbine. The turbine experiences torque multiplication. It transmits that to the rear wheels as added push. The twisting effort of the crankshaft has been multiplied at the point where it is put to work.

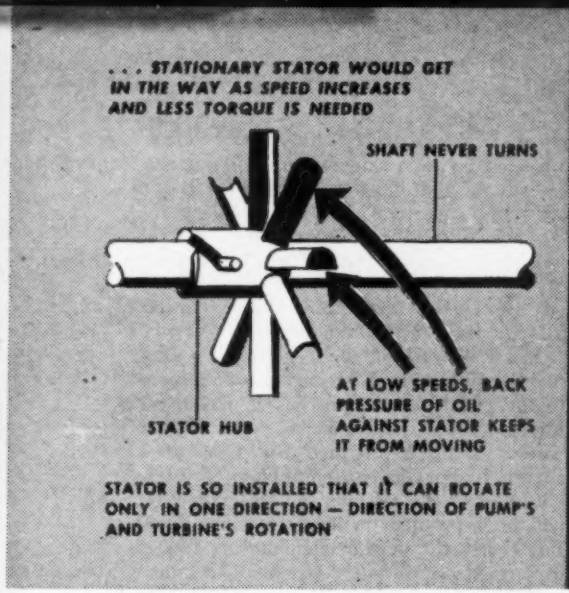
The evolvement of torque conversion by hydraulics early in this century was one of the world's great advancements in the art of power transmission. It works beautifully in constant-speed engines. It is near-perfect for high-capacity reduction drives.

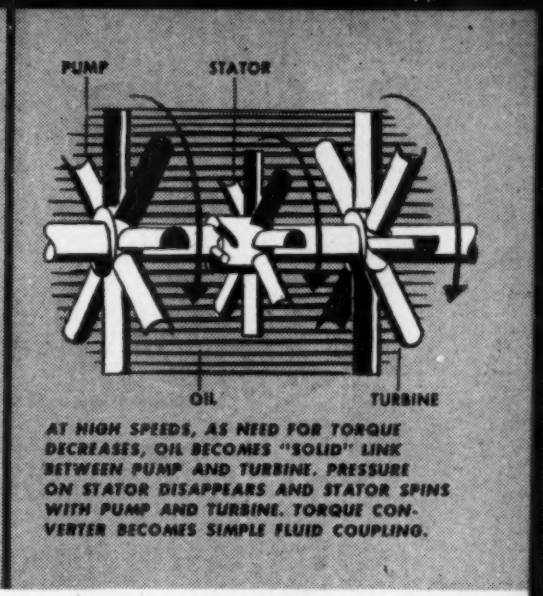
High Speed a Problem

But torque converters for automotive use were something else again. When engineers began fiddling with torque conversion for buses and passenger cars, they discovered that while the device worked fine at low speeds, at the higher ones the vehicles required, the entrails of a torque converter would put the oil into an uproar. As the rotational speed of the converter grew and the flow of the oil became completely rotary, the stators were only in the way. Power losses were colossal, and the outraged oil got hot enough to burn.

Yet there had to be some answer to the problem. It would be ideal if the torque converter, efficient at low speeds, could be wedded to the simple fluid coupling, efficient at high speeds. If it could be done, the completely fluid transmission would be a reality.

For the engineers, the fluid coupling itself was like money in the bank. That much had been accomplished. While the oil in the coupling did tend to slap pettishly at the pump when the accelerator went down, it "solidified" so quickly as a car gained





speed that for all practical purposes it provided a mechanical connection between engine and rear wheels.

The question was: What to do about the stators? What finally happened was forecast in POPULAR SCIENCE in its December, 1945 issue (pp. 144-45). The stators were mounted on a wheel that could turn *only one way*—in the direction that pump and turbine rotated.

That, in essence, is the new Buick transmission. So long as the torrent of oil needs

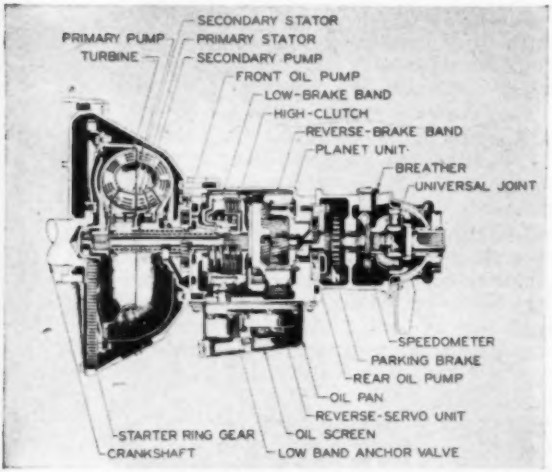
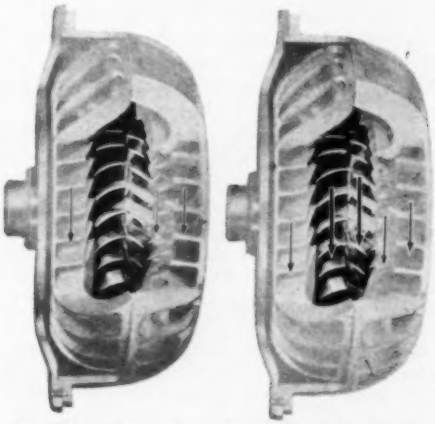
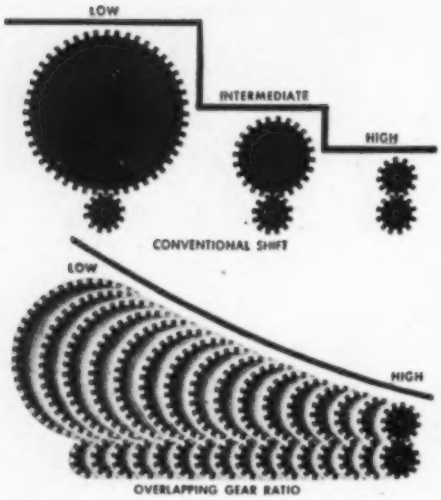


Diagram of Dynaflow transmission reveals that turbine that drives the wheels is at end nearest the engine, while engine-driven pump is behind it. This seeming contradiction is most efficient way to fit them in. Buick claims adequate engine brake when coasting as a result of the fact that the turbine then acts as a pump, and the pump as a turbine. Company cautions to push, not pull, car for emergency starting; otherwise it may accelerate suddenly into rear of tow car. While car is pushed, control lever should be left in neutral until 30 m.p.h. is reached.



Phantom views show the heart of the torque converter. In each, from right to left, are the primary centrifugal pump, secondary centrifugal pump, the two stator assemblies (darkened), and finally the turbine. Arrows on left drawing show what happens as car starts: pumps and turbine revolve in same direction; stators remain fixed. Right drawing shows action at high speed: as marked by arrows, the two stators start free wheeling in the same direction as the pumps and the turbine. The device now acts entirely as a simple fluid coupling.



Dynaflow torque conversion supplies the motorist with a "million gear ratios" instead of the conventional three, because the gradations in torque, or push, at the rear wheels are infinite.

redirection, the stators stand their ground. They give a helping hand to the pump. The oil they feed the pump supplies torque multiplication, just like the conventional automobile transmission gearing.

The pump declares its own dividend. When it needs a lot of help, it gets it. Through the turbine, it passes the added crankshaft twist on to the rear wheels of the car. As the car gets rolling and the speed of the turbine begins approaching that of the pump, the stators experience less pressure. The rear wheels demand less push. Less oil flows from pump to turbine and back from turbine to pump. Torque multiplication drops off. Presently there is no pressure at all on the stators. They float, revolving freely with pump and turbine.

The automobile's transmission, as such, disappears. Pump, turbine, and stators become a simple fluid coupling.

Buick is not the first to use the floating stator. It was introduced on buses shortly before the war. But Buick is the first to refine the system for mass-produced high-speed passenger cars. Because emergency low and reverse require mechanical gearing, the Buick transmission as yet is not completely fluid. And as yet it is only optional equipment on the Roadmaster model. It costs more.

Hydraulic torque conversion in principle is not too complicated. It is extremely complicated in application. Buick's stators are arranged in three stages. There is not one centrifugal pump but two, and the secondary pump over-runs the primary in certain load conditions. Two gear pumps are required to maintain oil pressure at various car speeds. A radiator is necessary to drain off excess heat from the oil. The system has a lot of other accoutrements.

Buick is worried about getting an adequate explanation of torque conversion over to the public. If a man has to pay extra for something, he wants to know how it works. Buick must face up, also, to a slightly higher fuel consumption in the present state of the art. As for servicing, that will be a problem in itself for some time. Buick smartly began schooling its dealer repairmen in torque conversion transmissions two months ago. The wayside garage man is in for some midnight study.

Smooth and Flexible Ride

But listen to an expert describe torque conversion. Carl A. Lindblom, chief engineer of the White Motor Co., pioneer in the field, says: ". . . it offers torque multiplication and automatically provides a smooth, flexible ride comparable to the result that would be achieved if infinitely minute progressive gearshifts were manually possible."

That means pressing on the accelerator is like opening the throttle on a locomotive.

". . . It permits the power plant to operate in its most efficient output range. It eliminates low-speed lugging and chugging in the critical detonation. (No ping.) As a result, better spark timing and higher compression ratios are possible . . . Vibrations of the engine and drive train are isolated and subdued. (Feels like sitting in your easy chair at home.) Vehicle life is extended, driver effort decreased, and passenger comfort increased."

That means that an automobile with a torque converter feels like an airplane in smooth flight. END

Mike Blares Umpire's Decisions

So THAT baseball fans in the bleachers will know the umpire's decision, Chas. H. Capp, of Philadelphia, has invented a small microphone to be mounted inside the umpire's mask. Wires run to studlike terminals fastened to the sole of his shoe. When the umpire steps on a sunken contact block behind home plate, his voice is heard over the ball park's loudspeaker.

Sand Sinks Oil Slick

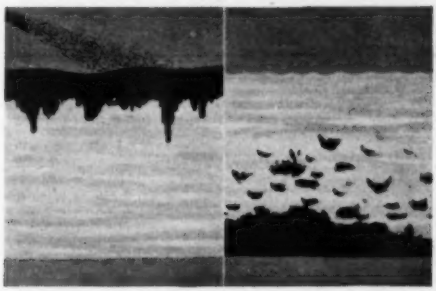
LATEST thing in fire-fighting is a novel method that puts out harbor fires caused by burning oil slick by literally sinking the oil right out from under them. More important, it removes the cause of such fires before they happen. Primarily a preventive, it was developed by the Navy following a serious oil-slick fire at Norfolk, Va.

Fine beach sand, heated to 700-800° F. in a revolving drum with a mixture of carbon asphalt and fuel oil, is coated with a layer of carbon. When this is sprayed on the slimy, highly inflammable slick, the carbon, having an affinity for oil but repelling water, adsorbs the oily scum, which is then carried to the bottom with the sand.

In addition to being inexpensive and easy to use, the carbonized sand can be sprayed around pilings and between ships, thereby reaching oily spots hitherto inaccessible.

Carbon-coated sand is poured into a standard sand-blasting pressure tank. A portable compressor can be mounted in a power boat for treating oil slicks under piers and off shore.

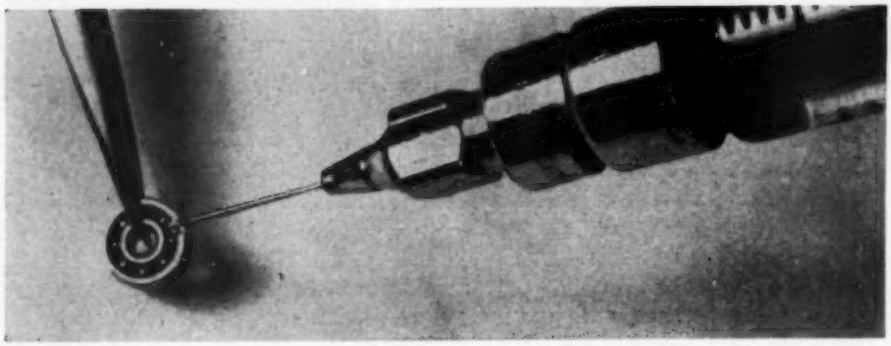
The sand is blown onto the slick under an air pressure just high enough to let it float without being driven through. About a half pound of sand will treat a square foot of surface.



The carbonized sand acts as a coagulant, clotting the slick into heavy, sand-laden lumps (above, left) that slowly settle to the bottom (right). Even if disturbed, they will sink back.

Sand blast scours slime-covered pilings, is ideal for such hard-to-reach places. Oil-covered, creosoted wooden piers, often inaccessible, have been the starting place for many a disaster.

Costly waterfront fires, like this one at Norfolk, Va., may now be a thing of the past. In a recent Naval test here, 6,000 square feet of slick were treated and removed in four hours.

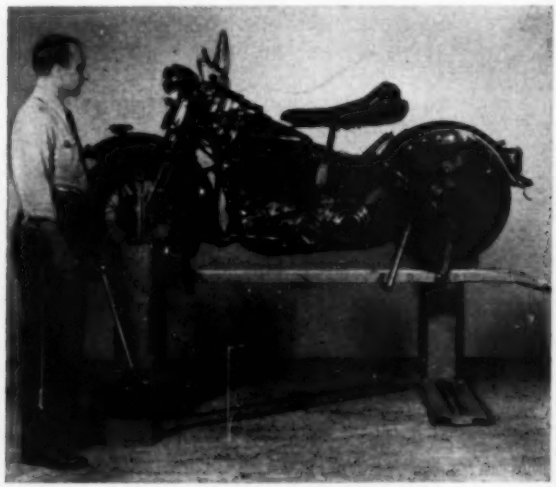


Ball Bearing Midgets

THE needle of a hypodermic syringe is the oil can that lubricates these tiny, nonmagnetic ball bearings. Claimed to be the smallest of their kind in the world, they have been developed by New Hampshire Ball Bearings, Inc. The bearings are made of noncorrosive beryllium copper, and are expected to find wide usage in electrical, electronic, and industrial fields where freedom from magnetic influence is a factor.

Wrist Watch that Rings

CRICKET is the name for this alarm wrist watch because the prowess of the tiny chirper of nature shamed Swiss designers into licking the problem of making a small precision timepiece sound off. The trick was done by setting a tiny steel peg in the center of a thin diaphragm at the back of the watch. A hammer, part of the movement, hits the peg, producing a noise loud enough to waken a heavy sleeper. Made by Vulcain, the watch above, at left is made of stainless steel; the one at right is of gold, with raised gold numerals. Button next to the regulation winder controls the alarm mechanism.



Motorcycle Gets Uplift

CATERING to two-wheel road jobs, this new hydraulic lift hoists a motorcycle to a working height and holds it firmly in place while the mechanic does an overhaul job from a sitting or standing position. The obvious advantage is that it eliminates stooping or kneeling while doing repair work. Holding arms that clamp to the frame of the machine are adjustable. Another product of the Thoro Corp., of Batavia, Ill., is the collapsible windshield shown on the motorcycle above. Rolling into a chromium tube, the shield works like a window shade, and can be raised and lowered as desired.

Cooling Off the Cast

TEMPERATURES must be kept down on Hollywood movie sets or temperaments will soar and makeup will melt. On a Technicolor stage, the thermometer will rise to over 100°, even on a winter day, unless something is done about it. Latest wrinkle in keeping the stars smiling and their powder dry is a mobile air-conditioning unit, shown above, at left, mounted on a small trailer.

Developed by C. G. Hokanson Co., of Los Angeles, one unit will lower the temperature as much as 25° over an area as big as a town lot. Adjustable vents enable the operator to direct filtered, cooled air up toward the hot lights, or along the floor so that no air motion is present when action is being shot. Engineer at right, above, is adjusting a Freon water-cooled compressor. A 30-hp. GE condenser serves the two air conditioners of each unit.

Nipples Slip On Easily

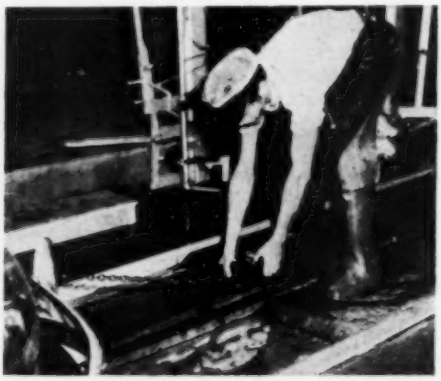
BABY can almost put the nipples on his own bottle with the Nipple On, made by Denlows Instrument Co., Jersey City, N. J.

Designed to let harassed parents change nipples without having to touch the bottle or running the danger of spilling it, the device has tongs for removing the heated bottle from the sterilizer (as at left, above). Four smaller prongs on the side are then inserted in the nipple, placed upside down in the bottle (center), and the handles are pressed together. This spreads the prongs apart, allowing the nipple to be picked up, turned over, and pulled down over the neck of the bottle (right). The prongs are then slipped out from under and removed.

How Cars Are Washed In Fast New Laundries

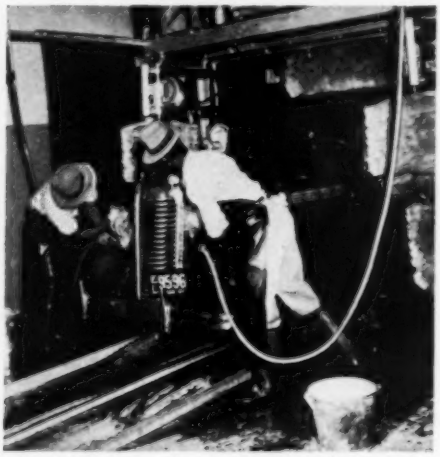
NOW you can have your car vacuumed, washed, and polished in less time than it takes to read this article. If you are in a hurry, you give your key to an attendant, walk to the cashier's window, and by the time you get change from a five dollar bill, your car, spick-and-span, is waiting to be driven off. More leisurely customers can leave their cars in an adjoining parking lot from which they are picked up to fill in the laundry's slack time. But even harried motorists often stay beyond their own three-minute car wash time to watch the spectacular blower-drier (PS, Feb. '47, p. 79). Made by Minit-Man Car Wash, of Detroit, Mich., the system is operating in many big cities.

Attendant using vacuum cleaner gives the car's interior a thorough going over. He then checks the whip antenna before sending the car on its way to the mechanical laundry.

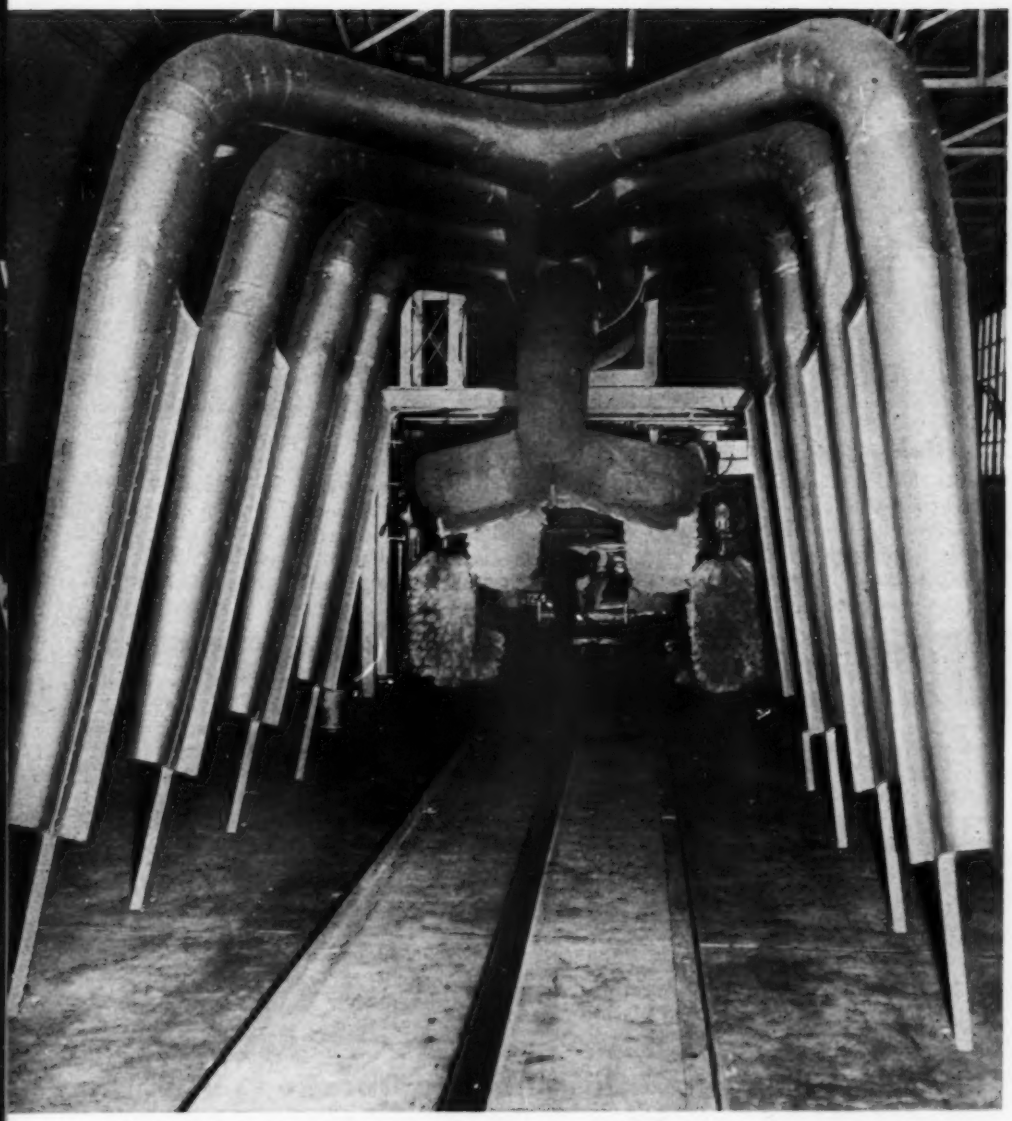


Bumper of a car is hooked onto a 75-foot conveyer chain that moves along the center of the floor. At the end of its brush, blow, and wipe trip, the chain is automatically disengaged.

Here the car gets the brush-up. Seven brushes, made of soft fiber that will not scratch, completely envelop the car. Canvas spray ducts on top are lined with soft sheepskin fleece.



Touch-up men take over and attack the hard-to-get-at places, such as bumpers and radiator grille. The wheels, spun by a rotating treadmill, already have been cleaned by the brushes.



Straddling the laundry-line exit like a giant spider, this drier does its job with the roar of a wind tunnel. With a 60-mile gale blowing over the car's surface, excess water is soon gone with the wind. Finishers, using white turkish towels, dry out any spots missed by the blower. Windows are then polished, and the car is ready. Total elapsed time: three minutes.

One Breath Equals Pint of Air

WITH each breath, the average man inhales enough air to fill a box three inches square and three inches deep. Breathing at an average rate of 16 times a minute, he takes in eight quarts of air every minute.

Hot Sun Means a Cool Earth

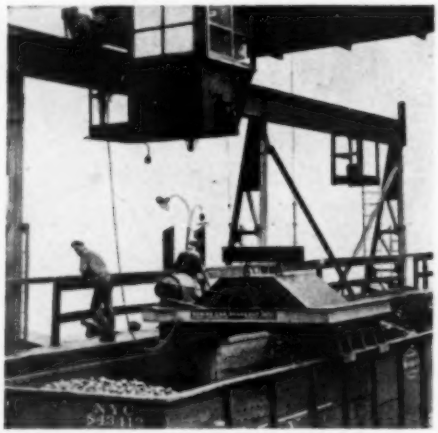
THE earth is coolest when the sun is hottest. At that time, the earth's atmosphere is stirred up, and the result is increased evaporation. This means more clouds and therefore more rainstorms, with resulting coolness.

Land-Based Flat-Top

GUNS "fire" and plane propellers spin on this 44-foot scale model of an aircraft carrier. Used for recruiting, she puts on a realistic battle action. Recorded explosions are accompanied by puffs of talcum powder; an air compressor whirls the props of the tiny Wildcat fighters. Above, right, workers at the North Island Naval Air Station, San Diego, Calif., are putting the finishing touches on the superstructure, made of scrap aluminum. Electric motors elevate the guns and rotate turrets and radar antennas.

Tiny Tube Has Long Life

THIS new midget dental X-ray tube, although not much larger than the tubes in your radio, is expected to take a 70,000-volt beating for 20 years. New feature in the tube is a copper hood surrounding the anode, which minimizes stray radiation that might blur the film. The hard glass of a small window through which the X-rays are transmitted is ground to a thickness of 1/20,000 of an inch. Made by Westinghouse, the tube is an improvement over a similar German one captured during the war.



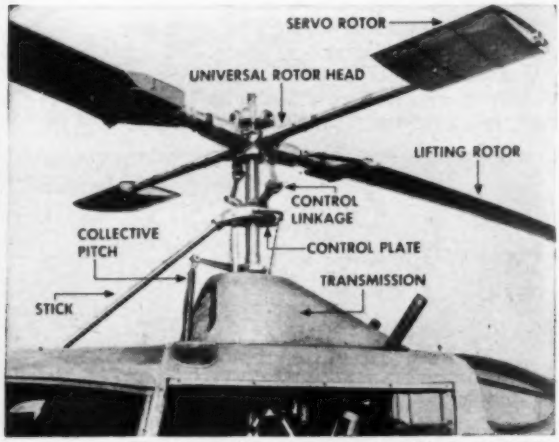
Shaking Out the Coal

THE "big shake" straddling the coal car above sets up a miniature earthquake that avalanches a 50-ton load through the hopper bottom in about two minutes. Previously, from four to six men using sledge hammers and crowbars took as much as two hours for the job—and might damage the car. The shakeout, made by Hewitt-Robins, Inc., of Passaic, N. J., is vibrated by the electric motor at left, and shakes the whole car. It is moved from one car to another by the five-ton hoist shown at top.

Helicopter Flies 'No Hands'

A BANE of helicopter flying has been the necessity of constantly manipulating the controls to keep the machine on an even keel. Airplanes would fly "hands off" but helicopters wouldn't. But now Stanley Hiller, Jr., of Berkeley, Calif., has produced a second version of his helicopter that will fly itself. (His first version was pictured in POPULAR SCIENCE, November, 1944, p. 90)

The helicopter, called the Hiller 360 model, is "inherently stable." If it is put in a bank or glide and the pilot takes his hand off the control stick, the machine will return to level flight. United Helicopters, Inc., of Palo Alto, Calif., which young Hiller heads, claims that the 360 is the first rotary-wing aircraft capable of doing this.



The "servo" rotor, whose two blades look like two sections of a model airplane wing, is the secret of Hiller's new superstable copter. It controls the main rotor aerodynamically.

The stick of a conventional 'copter changes the blade pitch of the main (lifting) rotor by a multiplicity of push-pull rods. Hiller's operates, instead, two blades of a small control rotor. The control rotor, in turn, changes the blade pitch of the main rotor to control the attitude of the aircraft. In effect, the control rotors act as an aerodynamic "servo." It multiplies the pilot's manual control just as servo motors on a fixed-wing airplane boost the commands given in the cockpit in passing them along to the ailerons, elevator, and rudder.

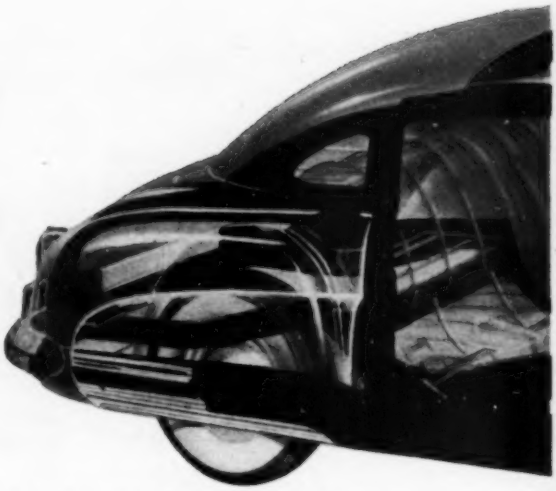
A by-product of Hiller's system is the reduction of the amount of vibration in the control stick. Normally, considerable vibration is fed back to the stick by the rapidly rotating lifting blades. Hiller says his control rotor is self-damping, eliminating such vibration feedbacks.

To connect his control stick directly to his rotor assembly, Hiller has replaced his between-the-legs stick with an overhead one (PS, Sept. '47, p. 93). Spring-balanced, the stick can be moved by a pressure of only 15 ounces. Like that of an airplane, it will always return to "neutral" when released.

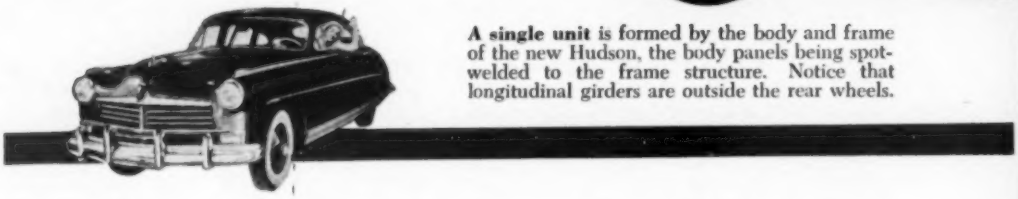
The 360 has a high speed of 105 m.p.h., a cruising speed of 85 m.p.h., can climb 1,000 feet a minute, and can voyage 212 miles in still air between refuelings.

New Hudson Hugs the Road

Although the average man can look over the top, there's lots of room for the big guys in this low-slung car.



A single unit is formed by the body and frame of the new Hudson, the body panels being spot-welded to the frame structure. Notice that longitudinal girders are outside the rear wheels.

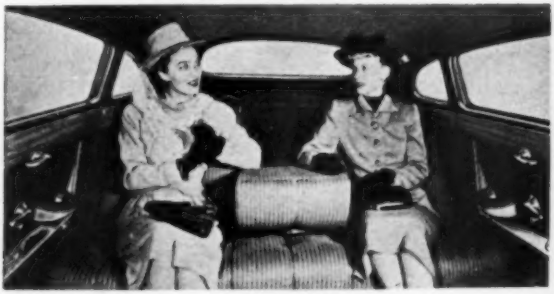


BODY and frame are one in the new 1948 Hudson—giving greater strength, rigidity, and passenger protection. Instead of an assembled body being bolted onto a built-up frame, the body and top panels are spot-welded to the horizontal and vertical members as shown in the phantom view above.

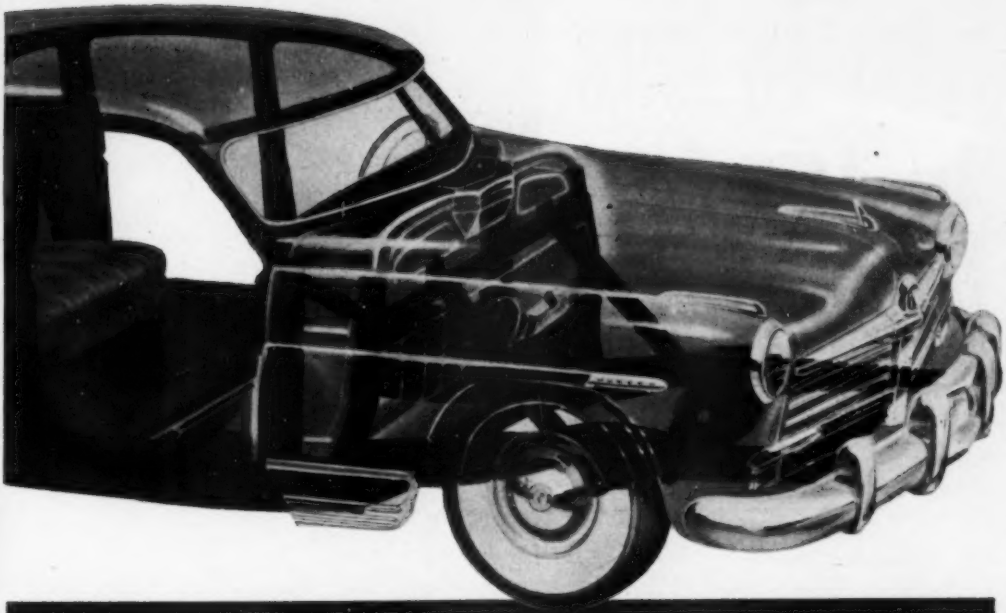
Going further than Nash and Lincoln, pioneers in the unified body field, Hudson runs the frame girders outside as well as inside the rear wheels, giving, in effect, invisible side bumpers. In fact, a large share of the $16,000,000 Hudson spent for current re-tooling was charged against this new body.

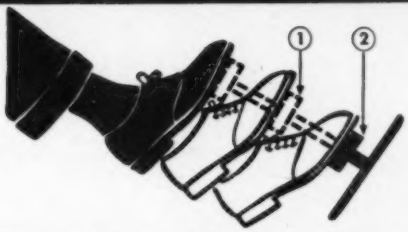
This all-steel Monobilt body-and-frame has enabled the company to turn out a car standing only five feet high, but with plenty of room for even the long-legged. By placing the floor under instead of over the frame (PS, Jan. '48, p. 133), Hudson engineers have come up with a low-slung car that has plenty of headroom, ample road clearance, and "the lowest center of gravity of any U. S. automobile." Engines of the new models have either six cylinders with 121 hp., or eight cylinders with 128 hp.

Tire changing is no problem, even though frame members are outside the rear wheels. With the car jacked up, the wheel goes under the girder after removal of a section of the chrome apron.

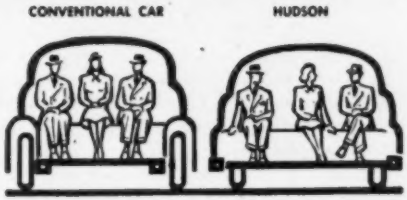


Space and comfort are both found in the rear seat. An arm rest for two persons folds down when needed, and recessed door controls give a full 66 inches of usable width inside the car.

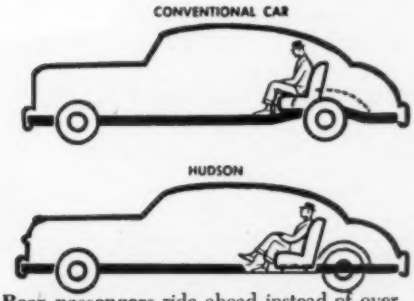




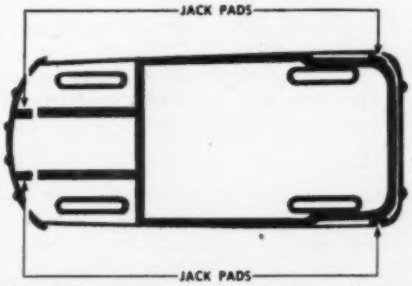
Reserve brakes provide extra safety. At point 1 the hydraulic system ordinarily gives full stopping power, but if you have to press the pedal to 2, mechanical brakes take over.



Since the floor is under the frame instead of on top, the Hudson has ample headroom, even though its height is only 60 inches. Over-all width of the new car is 77 inches.



Rear passengers ride ahead instead of over the wheels. To provide space for this, the engine was placed farther forward. The wheelbase is 124 inches; length, 207⅞ inches.



Box-type jack pads are found on the frame just behind the bumpers. Seated securely in these, the jack cannot slip. The rear bumpers are bolted directly to the frame of the car.

How to Run An Atomic Power Plant

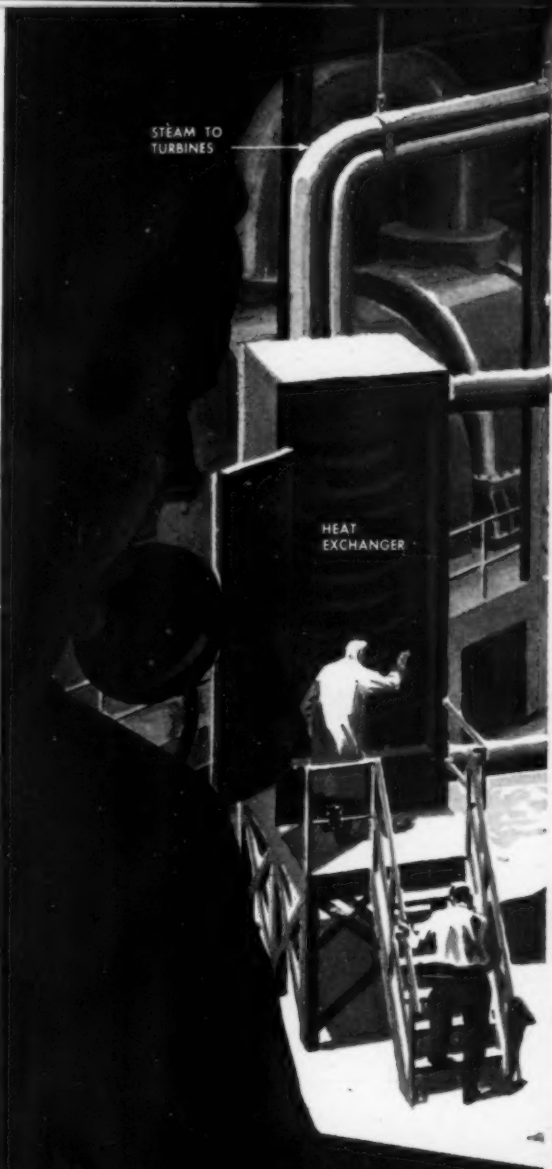
Nuclear research piles give preview of methods that may be used to make tomorrow's electricity.

By Martin Mann

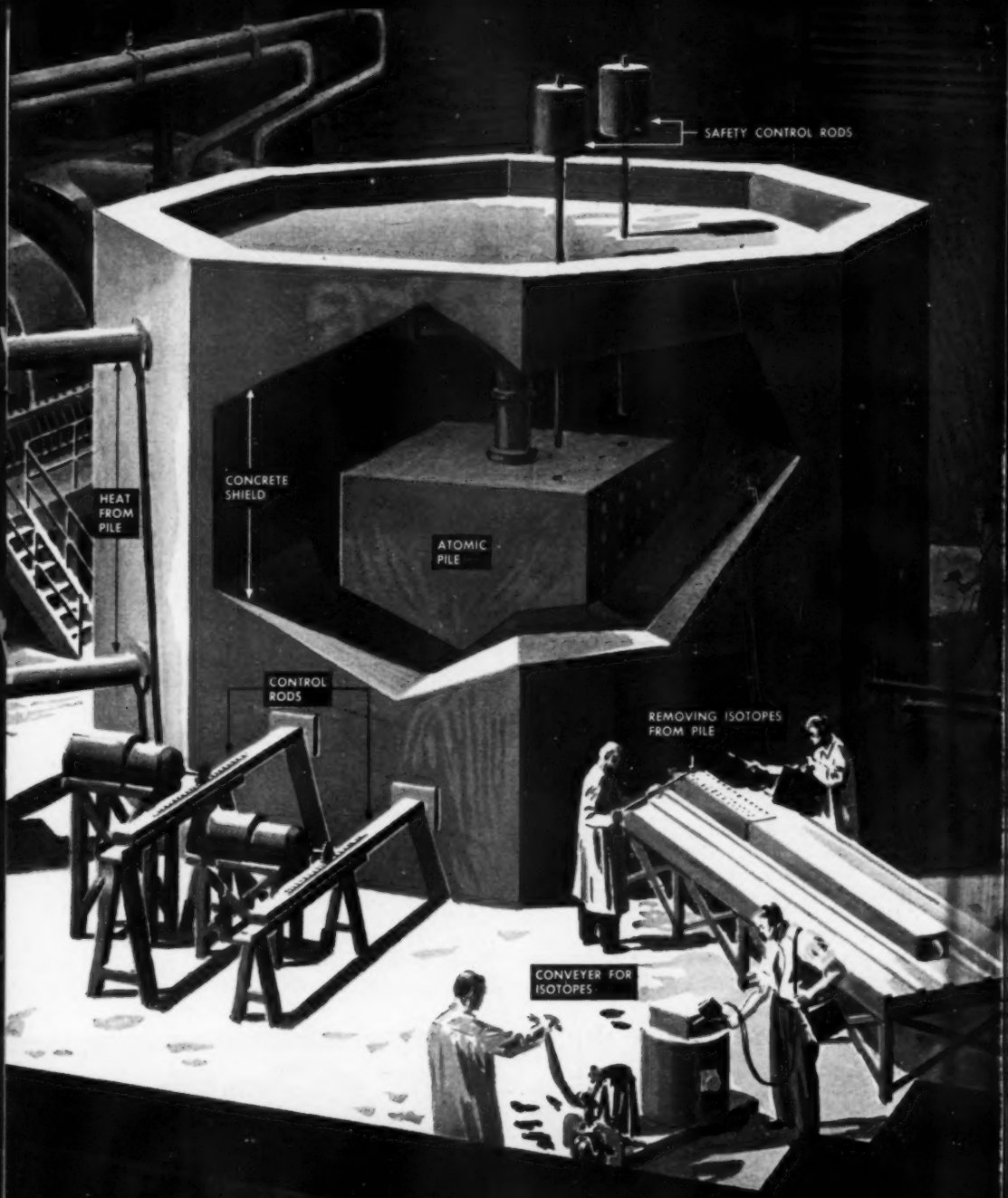
You—as a citizen—own a part of the 2½-billion-dollar atomic-energy industry. Although your individual share is only one in 143,000,000, it is probably the most important single thing you own. It provides the most powerful weapon in our arsenal for war, promises cures for many diseases, and will eventually furnish cheaper electricity and transportation.

YOU'VE heard a lot about atomic energy. But you probably have a lot of questions because so few people have actually seen an atomic engine. Well, I have. I was one of a small group of reporters who saw two nuclear piles early this winter. While they were operating, I touched them, stood on top of one, saw it turned on and off, watched as "hot" radioactive materials were taken out of it. So maybe I can help you visualize the process and get rid of some of the mystery.

Let's imagine you have just gotten a job running an "atom furnace." Sure I mean you! Some day such jobs will be as common as locomotive engineers. The engines of the future will be like the experimental piles I saw at the Argonne National Laboratory, which the University of Chicago runs for the U. S. Atomic Energy Commission.



Atomic power plant of future may look like this drawing. Some shielding omitted to show details.


SAFETY CONTROL RODS
CONCRETE SHIELD
HEAT FROM PILE
ATOMIC PILE
CONTROL RODS
REMOVING ISOTOPES FROM PILE
CONVEYER FOR ISOTOPES

CONTROL PANEL

The laboratory is hidden in a forest preserve on the outskirts of Chicago. You go through the guarded gates, pick up your badge and protective radiation detector. Your place is at the back of the room at a panel crowded with meters and dials. When you arrive, you find the pile shut off. Bringing it up to power will be your first task. You do this by turning a little crank that sends electrical signals to special motors called Amplidynes.

The Amplidynes slowly pull cadmium control rods out of the pile. Atomic fission starts, and increases rapidly in intensity as the rods move farther out. Cadmium is a metal that soaks up neutrons. Since neutrons are the bullets that split uranium-235 atoms, pulling the rods out permits more bullets to fly around and more atoms split. Sliding the rods *in* cuts the bullet supply and reduces the fission. Sliding them all the way in stops it cold.

Watch the Birdie

You keep your eyes on the scale of the galvanometer (a sensitive ammeter) while adjusting these rods. A spot of light moves across the galvanometer's translucent scale, indicating the power level. It takes some careful back-and-forth cranking of the control handle to get the pile to exactly the power you want, but once you hit it, automatic control equipment takes over and keeps it there.

A number of detectors, sensitive to radiation, are built right into the pile. When they notice any change from the desired power level, they signal the Amplidynes to adjust the control rods. In an emergency the detectors signal other Amplidynes operating shut-off rods, which move into the pile with a resounding clump and stop it.

Typical of experiments with pile is this test of neutron-absorbing ability of various materials. Spectrometer (gunlike device) sorts the neutrons from the pile (rear) according to speed.

The automatic controllers leave the operator little to do except watch the dials and wait until the intercom squawks an order to change the power level. The pile is right behind him, but all he sees when he turns around is an eight-sided concrete block about as big as a small two-story house—with no windows or doors.

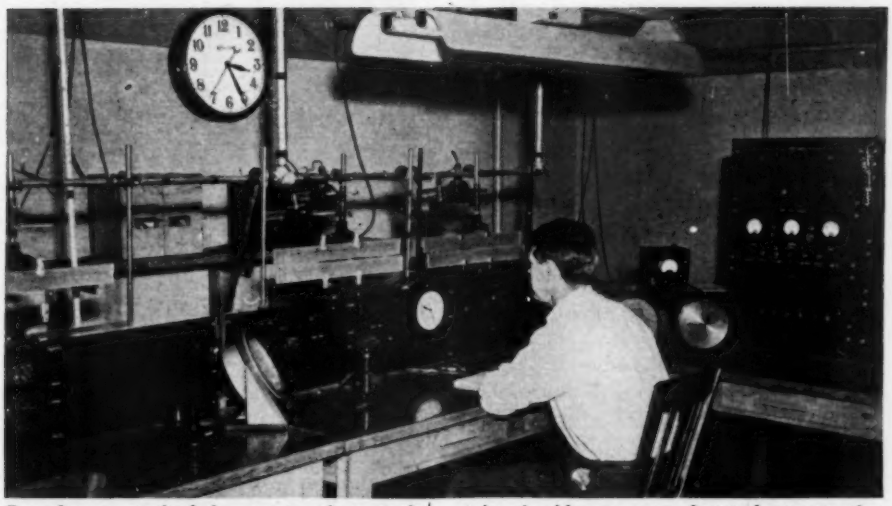
Even when the pile is yielding full power, 300 kilowatts, the only sound is a faint background hum—and that is only the fans in the building's heating system. Occasionally there is a whine as gears in the control boxes move to adjust the rods and keep the power level steady.

You can also see some piping right behind

How Man Can Use the Atom

Cheaper electricity is the ultimate peacetime promise of nuclear energy. No power pile has yet been built, but most physicists think one could be made if proper construction materials are found. It may be many years, however, before atomic power is less expensive than coal.

Plutonium for a bomb so powerful that one can destroy a whole city is made in an atomic pile. Neutrons transmute the natural uranium-238 to the man-made element plutonium, which fissions as does uranium-235. Minute traces of natural plutonium have been found.



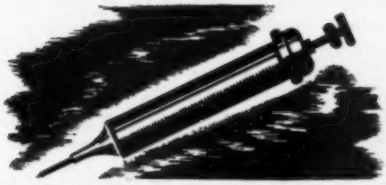
Complete control of the atomic pile is at the finger tips of this one operator. The output of power is indicated by spots of light on ruler-like scales in front of him. Wheels near his right shoulder operate electrical circuits that adjust cadmium rods to raise or lower power level. This is the control room for the 1 KW graphite pile at Argonne National Laboratory.

your operating position. These are the inlet and outlet pipes for the water-cooling system. The water, which keeps the pile from overheating, does not run into the pile itself (the neutrons would make it dangerously radioactive if it did), but flows through pipes behind a concrete shield, where it absorbs heat through a heat exchanger from another set of pipes containing heavy water, which looks and tastes like ordinary water, but contains a special kind of hydrogen twice as heavy as ordinary hydrogen. The heavy water does flow in and out of the pile (but not outside the shield), taking the heat out. The heavy water is radioactive, but does not affect the cooling water.

Some system of this kind will be needed to get the heat out of an atomic pile designed to furnish electric power, for *a power pile is simply a heat-making machine,* just as a coal furnace is.

Wanted: a Better Heat-Transfer Fluid

An efficient power pile must operate, however, at much higher temperatures than Argonne's low-temperature research pile. Heavy water, a very satisfactory heat-transfer fluid at low temperatures, will not work so well at high temperatures. Some other fluid, which can stand high temperatures and absorb few neutrons (so that it doesn't interfere with the chain reaction) will have to be



Medical research has benefited greatly from the radioactive isotopes manufactured in the atomic piles. These isotopes can be used in place of radium in treating diseases (they are cheaper and often better) and as tracers to tell where substances go inside the body.

As a research tool, the atomic pile is expected to add much to our store of knowledge. Drawing above shows what happens when a neutron hits a nitrogen nucleus in a cloud chamber—it knocks an alpha particle out (light line), and the rest of the nucleus recoils (heavy line).

used to transfer heat out of power piles, but what that material will be is still a question. That's one reason nobody has built a real power pile yet. A good heat-transfer fluid will probably be found among the metals that melt easily—bismuth might be a possibility.

Heavy water also has another job in this particular pile. It is the moderator that slows down the neutrons enough to keep the chain reaction going. It is one of the few materials that make good moderators.

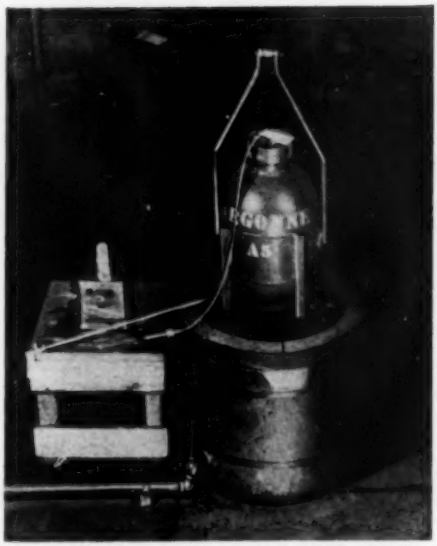
At Argonne, the space around the pile is cluttered with instruments, for this is a physics laboratory—it even smells like one. The pile is being used simply as a machine to produce neutrons, and the neutrons are being used in attempts to find out why atomic nuclei act the way they do.

Neutron beams for research come out of the pile through small holes in the thick concrete wall. When not in use, these are closed by cadmium plugs. Before a hole is opened, the area where the beam will shoot out is carefully roped off and the instrument setup checked by a "health-physics" inspector. He also tells the scientist conducting the experiment how long he may work there. For this beam can be as dangerous as X-rays: it can't be seen, or smelled, or heard, or felt and its deadly effects pile up over a period of time.

Life with an Atomic Pile

If you keep out of the way of the research beams, however, you are perfectly safe. No neutrons leak through the thick concrete walls of the pile. According to Dr. Walter H. Zinn, Argonne's director, you could set up housekeeping beside the pile and live there safely the rest of your life. A radiation counter held flat against the pile wall clicks slowly, registering only the cosmic rays that shower the earth everywhere. But when the counter is held in front of an open beam hole, the clicks speed up until the counter chokes, no longer able to keep track of the vast number of neutrons emerging. An atomic *power* pile, of course, would have no holes for research beams and would be still safer.

The only other place where radiation can get out of the pile to cause harm is at the "thimble," a hole surrounded by lead blocks on the roof of the pile. Through the thimble, materials can be inserted into the pile to be bombarded by neutrons and turned into the "tracers" that promise so much in medical research (see "Mail-Order Isotopes," PS Nov. '47, p. 87). The pile is shut off when the thimble is opened, so that few neutrons pop out, but many deadly gamma rays escape through the hole.



To get "hot" material out of the pile, scientists fish for it with grappling tongs, pull it up through the "thimble" (lower right) and into the "lead coffin" (bomb-shaped container).

Even so, there is little danger, thanks to meticulous safety measures. The raw materials are placed in small aluminum cans and lowered into the pile with a long flexible shaft having claws on its end—a gadget much like a plumber's snake.

Snakes and Coffins

Getting the materials out of the pile after they have been made radioactive is more tricky, for each small can may give off as many killing gamma rays as 1/6 ounce of radium. A "lead coffin," a bomb-shaped lead container that can be opened top and bottom, is lowered over the thimble and opened. The snakelike tool then drops through the coffin and thimble into the pile, picks up the isotope can, and pulls it into the coffin. The bottom door of the coffin then is closed, the snake freed from the can, and the top coffin door closed. The "hot" isotope is thus surrounded by six inches of solid lead and can be carried safely anywhere.

Some opening like the thimble will probably be standard equipment even in a power pile. Most experts think that radioactive

Another way of getting things in or out of the pile is with this compartmented slide. The man at right is measuring radioactivity of newly made isotope, which is inside can held in tongs.

Materials that lose their radioactivity after a few seconds and so must be handled quickly are shot in and out of the pile through the "rabbit" pipe. Helium gas furnishes the push.

isotopes will be a profitable sideline for power companies. And besides, there will have to be some way to take out used-up uranium and put in fresh fuel. Uranium replacement is not a problem with this pile, since it operates at such low power that the original charge will last about 30 years. But a commercial atomic power plant will run at a much higher power level and need new fuel—though not nearly so often as a coal furnace does.

Pile No. 2 Is Right Across Hall

Argonne's second pile is set up in a similar room just across the hallway. Atop it is an enclosed room—another building within a building—in which experiments are conducted with the neutron beams coming up through holes in the floor. There are no holes for beams in the sides of this pile. Nor is there any special cooling system, since this pile operates at only one kilowatt and doesn't make much heat. Instead of heavy water, the moderator that slows down neutrons is graphite (the "lead" of lead pencils), and this will probably be used in atomic power piles, too. Recently, however, a controllable pile using plutonium and fast neutrons has eliminated the moderator, so it may not be needed in power piles.

Some of the metal parts used around the Argonne piles—such as the long-handled tongs that hold materials in the neutron beams—are made of aluminum, because aluminum absorbs few neutrons. But aluminum would not be much good in a power pile, because it would melt at the high operating temperature. This is another of the tough problems facing the designers of atomic power plants. Steel can stand very high temperatures, but absorbs so many neutrons that the chain reaction would stop, or at least become very inefficient. One metal that meets both temperature and neutron-absorption requirements is beryllium. Unfortunately, it's rather scarce and hard to work.

Research aimed at filling these gaps in engineering knowledge has already started at several of the Atomic Energy Commission's laboratories.

How long will it take? Some scientists estimate only two years will be needed to make the first electricity from atomic energy —experimentally. Uranium may not compete on a dollar-and-cents basis with coal, however, until much later. Where cost is not the most important factor, you may see atomic power fairly soon. Uranium-fueled battleships and submarines, able to cruise for years without refueling, may be afloat within five years. END

Uphill Pull Made Easy

ADAPTED from the ski tow, this overhead trolley system gives tired coal miners an "assist" up a steep hillside from the mine entrance. A worker simply grabs a rod traveling at 180 feet a minute, and hangs on until he reaches the top. The system was installed by the Link-Belt Co. at a Jones and Laughlin mine in Washington County, Pa.

Gates Grasp Boxcargo

THE latest Pennsy boxcars, 10 to 20 feet longer than standard, not only carry extra big loads but deliver them in better condition. To prevent shifting, the steel gates shown above are locked across each section after it's loaded. Hinged shelves drop to form an upper floor that keeps the top half of the load from damaging the lower part.

New Calculating Wizard

EDSAC, a British cousin of our electronic mathematical brains, such as ENIAC and EDVAC (PS, May '47, p. 95), will handle 10,000 multiplications a minute. Now under construction at England's Cambridge University, EDSAC will remember details of calculations and use "judgment" in choosing the best way to reach a result.

A wad of cotton held over the throat of a supersound generator quickly bursts into flame.

Silent Sounds Are Hot

A Pied Piper is coming to your house whose lethal tunes are too high-pitched for you to hear.

PS photos by W. W. Morris

SOUNDS, so high-pitched that you cannot hear them, sterilize food, mix paints, kill germs, clear away fog and smoke, and wash clothes. In the not-too-distant future such sounds may also keep your home free of insects, mice, and rats. To fill a room with such inaudible, useful noise, you may simply plug a "silent sound generator," no larger than a small table radio, into an ordinary electrical outlet.

The relatively new field of research that promises you such conveniences is called "ultrasonics." Scientists specializing in it are finding countless uses for their silent "supersounds." It would be difficult to name an industry in which some application of supersounds cannot be employed. Ultrasonic experts hesitate to draw any limiting borders around the field that they are exploring.

Every sound is a vibration or wave. Sound waves in the air are like the ripples that

form on a pond of water when you drop in a pebble, and the pitch of any sound depends on how many waves are formed per second. The fewer the waves, the lower the frequency and pitch; the greater the number of waves, or cycles, every second, the higher the pitch. Hit the lowest key on your piano's keyboard and the sound you hear is produced by 27 waves a second. Touch the last key at the high end and you set up 3,500 waves a second.

No Limit to Number of Sounds

Theoretically, there is an unlimited scale of sounds. They range from the extremely low-pitched sounds that might be produced by a fraction of a wave a second to extremely high-pitched sounds developed by an infinite number of waves a second. The human ear, however, is sensitive to only a small part of this sound spectrum. The lowest note on a large organ—about 16 waves a second—is about as low as our ears can hear. Eighteen thousand waves a second is about the normal ear's upper limit. Above that is the realm of ultrasonics.

Supersounds in that fascinating realm can be produced either electrically or mechanically. In an electrical system, high-frequency alternating current is passed through a small quartz crystal. This causes the crystal to expand and contract rapidly to set up the ultrasonic waves. The action is similar to that of a crystal-type loudspeaker. This type of generator can produce supersounds with frequencies as high as 12,000,000 cycles a second. But the effective range of these sounds is so short that the vibrations must be transmitted either directly, by actual contact with the material to be treated, or indirectly, through the almost incompressible medium of a liquid.

A mechanical supersound generator cannot produce such terrifically high frequencies, but can beam its vibrations through the air so effectively that its ultrasonic effects can be felt at some distance.

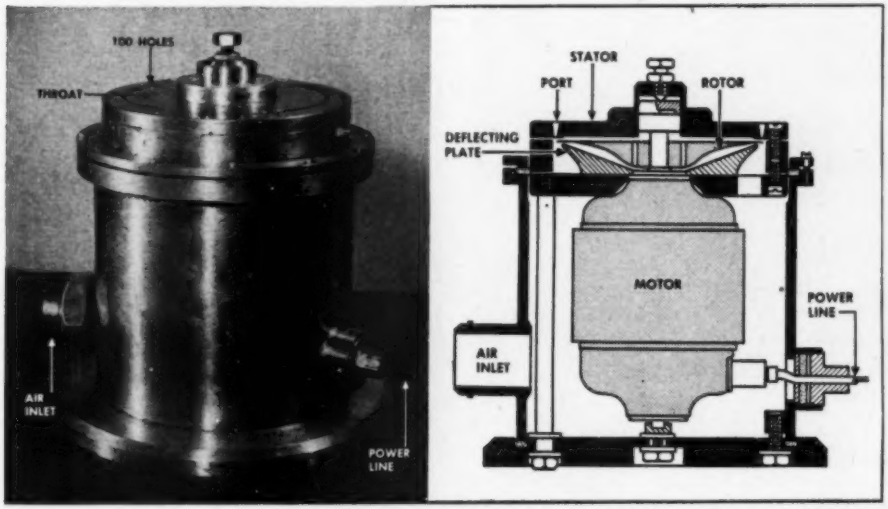
Typical of the mechanical silent-sound producers is a "supersiren" now being used experimentally in the Acoustics Laboratory of Pennsylvania State College at State College, Pa. It was perfected by C. H. Allen and Dr. Isadore Rudnick in cooperation with Dr. H. K. Schilling, the laboratory's director. This supersiren is capable of producing inaudible sounds with frequencies as high as 34,000 cycles a second—about twice the pitch that can be heard by the human ear.

Compressed air forced into the siren's main chamber tries to escape through 100

Supersiren in use at Penn State College. The technician, with his hand on a compressed air valve, wears special ear plugs for protection when the siren is operated in the audible range.

Here the ingredients are prepared to brew coffee with silent sound. The waves coming from siren's throat, vibrating 18,500 times a second, will quickly boil the water.

small, conically shaped holes spaced evenly around the siren's head. But before the air can escape, a whirling, sawlike rotor with 100 U-shaped teeth chops it into tiny puffs or pulses. Each puff becomes a sound wave, and what comes from the siren's throat is sound. Since the rotor, or air chopper, is rotated by a variable-speed electric motor, the experimenters, simply by varying the speed of the rotor, can run the gamut of

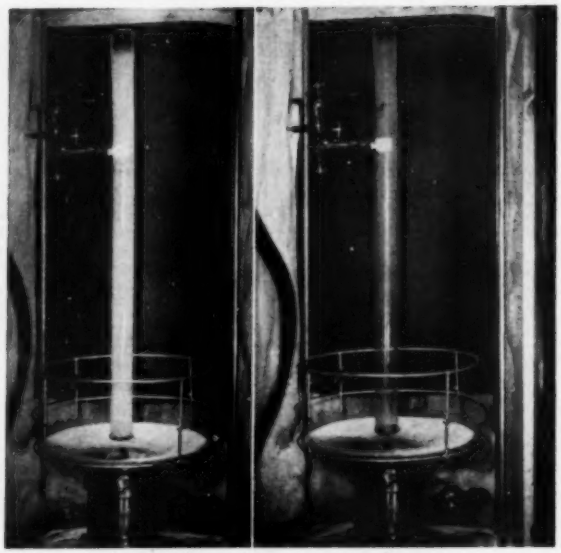


Simple in operation, the supersiren shown above is just a glorified high-speed meat grinder in which a stream of air replaces the meat. It chops air into rapid-fire puffs to produce high-frequency sounds the same way that a bicycle or fire-engine siren produces audible howls.

Lower part of the laboratory-made coffee pot is placed inside the throat of the supersiren, with the funnel that holds the coffee sticking out. Water will boil in less than six minutes.

Here bottom flask part is wrapped in a wad of glass wool preparatory to coffee-making demonstration. The glass wool absorbs the sound energy, becomes hot, and in turn heats the water.

Marbles are floating on sound in this demonstration of the siren's power in the audible range (about 3,000 cycles a second). For protection, operators must wear ear plugs and rubber muffs.



This experiment shows how supersound can dispel fog. At left is tube of water vapor before the siren was turned on. At right is the same tube 3½ seconds after the siren was turned on.

sound through the audible range to the inaudible. At 1,800 r.p.m. the siren produces an audible sound of such intensity that the average observer with ears unprotected is stunned—and sometimes nauseated.

When the rotor speed is boosted to 11,000 r.p.m., sound is still there but its frequency is above the ear's ability to hear. Finally, as the rotor reaches its top speed of 20,000 r.p.m., it silently screeches a supersound produced by more than 30,000 waves a second.

Sound Waves Can Burn and Boil

The sounds that this supersiren produces can be used to do an amazing number of things. Hold a piece of cotton over the throat and it bursts into flames in a few seconds. Put water over it and it boils in a matter of five or six minutes. Its sound waves will even pop corn.

Sound is energy, and the energy coming from the siren's throat is equivalent to about two kilowatts—enough energy in the electrical sense to light 50 ordinary 40-watt household electric lamps! That energy can be put to use in many ways.

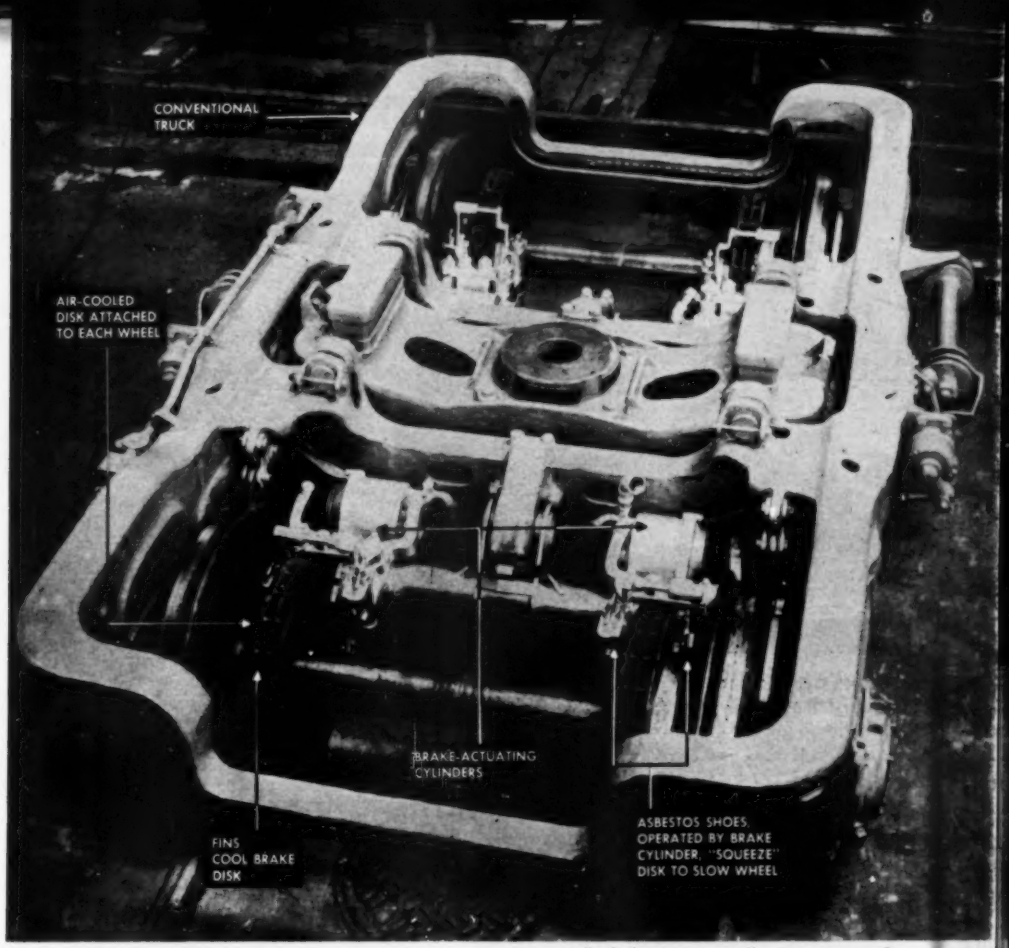
The waves can kill germs, bacteria, insects, and rodents literally by cooking them with the sound energy that their bodies absorb. If just the right frequency, or range of frequencies, is used, sound can scare away birds, insects, and other pests. It can precipitate soot and dirt from the air to help keep our cities clean. Directed at clothes, it can shake the dirt loose more effectively and in less time than any conventional washing machine or vacuum cleaner!

At least a dozen large dairies are using the vibrations of sound waves to homogenize milk. Similarly, manufacturers are testing the abilities of sound to mix paints, blend face creams and salad dressings, and produce permanently "shaken-up" medicines.

In California, at the Navy's landing-aids testing station near Arcata, a giant sound horn is being perfected to jar fog particles into rain drops as a means of dispersing fog over airports.

Supersounds also are giving manufacturers and maintenance men a quick and sure way of checking metal parts. Supersounds vibrating millions of times a second and aimed at a part being tested bounce back when they hit a flaw and indicate the imperfection to the machine's operator.

Medical researchers and manufacturers all hope that the silent sound experts with their supersirens will be able to help them solve some of their unsolved problems. END



Trains Get a Brake

NEW disk brakes stop a train so silently and smoothly that the passengers scarcely feel it when the engineer jams them on in an emergency. Developed by the Budd Co., of Philadelphia, they will halt a 100-m.p.h. train in less than 2,500 feet without a jolt—or damage to brake or wheels. That's 1,000 feet less than is required by the best conventional clasp-type brakes.

Main problem in designing the new brake was to get rid of the immense heat generated when the shoe gripped the disk. By using two small, lightweight shoes insulated with asbestos the heat is forced into the cast-iron disk. This has multiple cooling fins to throw off the heat as it revolves.

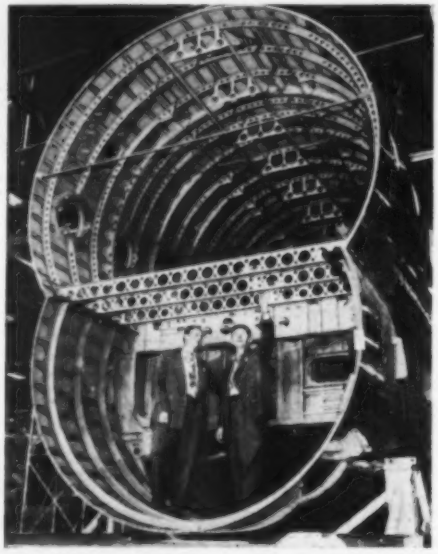
The new brake is said to last 10 times as long as one with cast-iron shoes, and to double the life of the wheel. There is a minimum of parts, and the simplified design permits the shoes to be changed quickly. Brake linings last up to 105,000 miles.

Junior Station Wagon

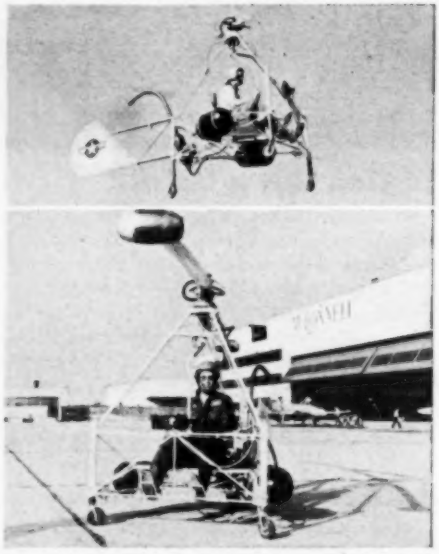
THIS all-steel, four-passenger Crosley station wagon is small but roomy—and it sells for less than $1,000 at the Marion, Ind., factory. With the rear seat removed, there is a 26-cubic-foot space for baggage. A commercial version of the station wagon, a lightweight panel delivery truck, has a quarter-ton carrying capacity.

What's New in Aviation

Testing Built-In Jato. With three of its 18 auxiliary rocket motors going off in a cloud of smoke, Boeing's XB-47 nears the end of its preflight tests. The six-jet bomber (PS, Dec. '47, p. 94) is the first plane to have jet-assisted-take-off units built into the fuselage. They provide a total of 18,000 pounds of thrust.

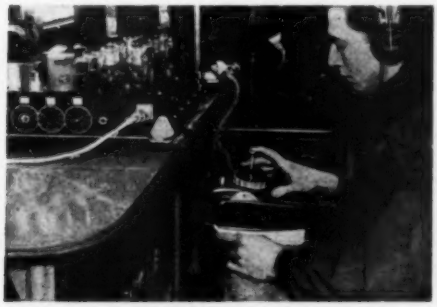


Double-Decker in the Making. The two-story fuselage of a Stratocruiser while still under construction serves as a classroom for air-line men. They take a three-week course to get acquainted with the 67½-ton plane before it starts passenger service.



Ramjets Hoist "Little Henry." Two small ramjet units, one at the tip of each rotor blade, power this McDonnell helicopter, first of its kind. In flight (top), the Air Force's "flying motorcycle" does 50 m.p.h., carries 300 pounds.

British Newcomer. The elongated Bristol 171 is Britain's first commercial helicopter. A four-seater, it is designed to do a variety of jobs, including air-taxi work. Its low-slung rotor blades fold back along the fuselage for parking in tight spots.



Finger-Tip Flying. Nearest thing to no-hands piloting is this tiny control unit that makes a plane respond to finger-tip pressure. It is part of a lightweight, all-electric automatic pilot developed for the Navy by General Electric.

XL-15 Folds Up for a Tow. With wings and tail surfaces removed and then latched to the sides of its fuselage, the Army's versatile XL-15 liaison plane turns into this neat package that can be towed up to 40 m.p.h., easily hidden or stored.

Auto Plus Wing. Mounting a wing and a 190-hp. engine on top of a four-place car, Consolidated Vultee engineers turned out this experimental flying auto. With the wing detached, the 900-pound glass-fiber car has its own 26½-hp. engine for highway travel. The machine cracked up during tests, but work on it is continuing.

Flying Freight Train

Nine-foot-high main wheels, inherited from B-36, give the XC-99 a slightly nose-heavy look,

Equal to 10 boxcars, the Air Force's XC-99 is world's biggest land plane.

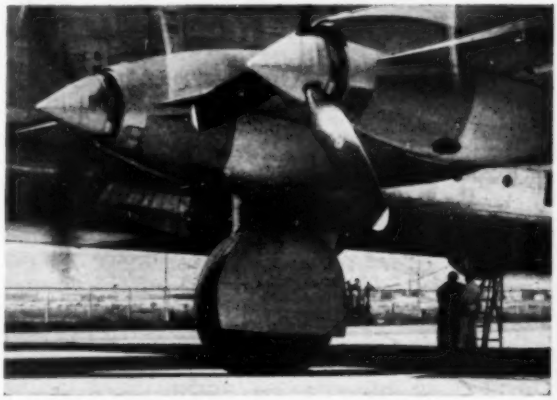
DESIGNED to carry 400 troops or 100,000 pounds of cargo at speeds up to 300 m.p.h., the XC-99 is the U.S. Air Force's newest heavyweight—the biggest chunk of flying machinery ever to take off from a runway.

The huge cargo carrier was developed by Consolidated Vultee from the B-36, which it resembles, but it outdoes its bomb-toting predecessor by 20 feet in length, 10 feet in height, and a lot of space inside. The two cargo decks of the XC-99 have a total volume of 30,000 cubic feet, equal to 10 railroad freight cars.

The fuselage is 182½ feet long, the tail assembly 57½ feet high. The 230-foot wing, seven feet thick at one point, has 18 fuel compartments that hold 21,116 gallons of gas. That supply would last an average motorist about 20 years; feeding the six pusher engines of the XC-99, it gives the plane a maximum range of a little more than 8,000 miles.

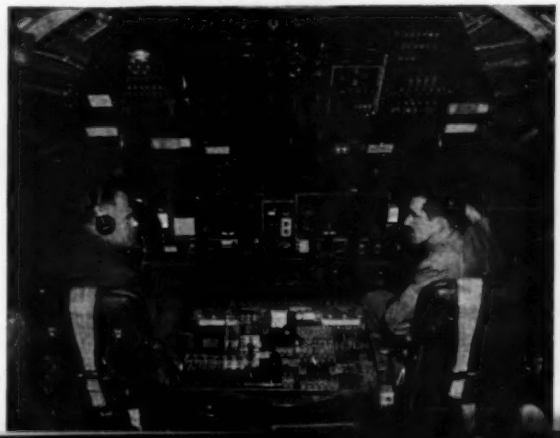
The engines are so-called "power eggs"—complete interchangeable units—turning out 3,000 horsepower each. In early flight tests, they got the 265,000-pound plane off the ground in about 4,000 feet.

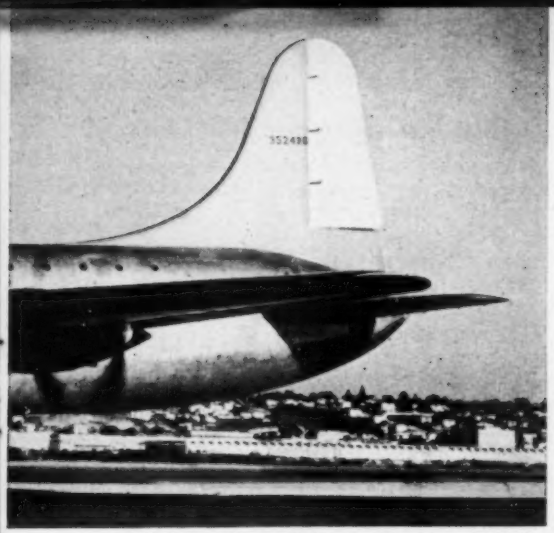
In spite of the XC-99's bulk, its pilot has no hydraulic control system to help him fly it. Instead, he moves spring tabs in the mammoth control surfaces (almost as big as the entire wing of a B-24), and air pressing against the tabs moves the control surfaces.



Nineteen-foot propellers have reversible pitch and built-in, thermal anti-icing system. Each of the six 28-cylinder engines has two turbo-superchargers for flights up to 30,000 feet.

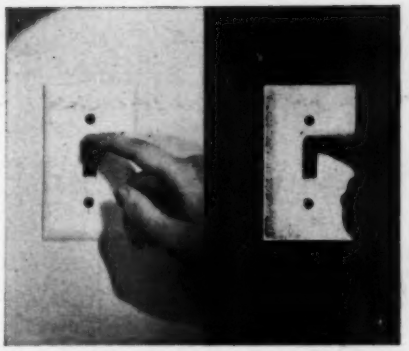
Mass of instruments is compactly arranged in flight compartment. To avoid duplication of controls and aid communication, flight engineer sits between and slightly behind pilots.





which is enhanced by the five-story tail fin.

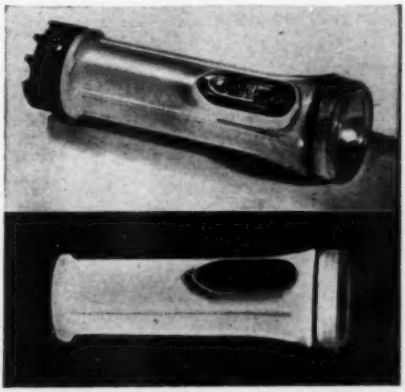
Looking aft along the tunnel-like upper cargo deck gives an idea of its capacity; it is 130 feet long, 7½ feet high. Lower deck has electrically operated sliding doors for dropping cargo in flight. Eighty-six windows provide light, and 12 exits are available for escape in case of forced landing or ditching.



Light-switch panel of du Pont's phosphorescent Lucite was photographed in the light (left), then in darkness (right). New Lucite has all the wear-resistant qualities of the old.

Putting a Glow Into Plastics

PHOSPHORESCENT plastics that glow for as long as 12 hours after exposure to light are now available for commercial uses. Promising new tricks galore for the ever-growing field of plastic products, the glow is achieved by adding special pigments to existing plastic compounds, which are otherwise unchanged. Possible applications include indoor and outdoor signs, light switches, ornaments, instrument panels—anything a manufacturer wants to make visible in the dark without bothering about a continuous power supply.



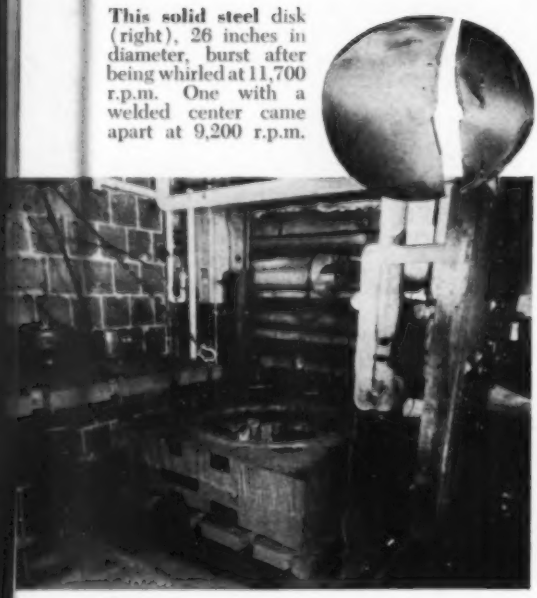
Flashlight molded of Monsanto's Lustron gives light even when it isn't switched on. Maximum brilliance is attained immediately after exposure; glow persists long afterward.

10,000 Volts for a Dollar

HERE is a bargain-basement generator that demonstrates how larger, atom-smashing machines get their power. Built by Eric F. Cave, a University of Missouri student, the half-million-volt machine is a junior version of the huge Van de Graaff generator at Massachusetts Institute of Technology.

The main machine consists of a high-voltage, biscuit-shaped electrode terminal on top of an insulating column. To make it go, a 10,000-volt direct current is sprayed on the lower part of a 10-inch-wide endless fabric belt running through the column. By this means charges are ferried up and collected at the top terminal until the desired voltage is attained. The amount of charge delivered at the top depends on the speed at which the belt moves. Once started, the generator becomes self-exciting. For demonstration purposes, the spherical terminal shown at left is brought close to induce a miniature bolt of lightning, as long as a foot, to leap between the two electrodes, or terminals.

Made in the school machine shop, the supporting column came from junked X-ray apparatus; the motor to run the belt and other electrical parts were war surplus. Costliest items on the total $50 expense sheet were the belt and the sheet aluminum from which the shells were constructed.

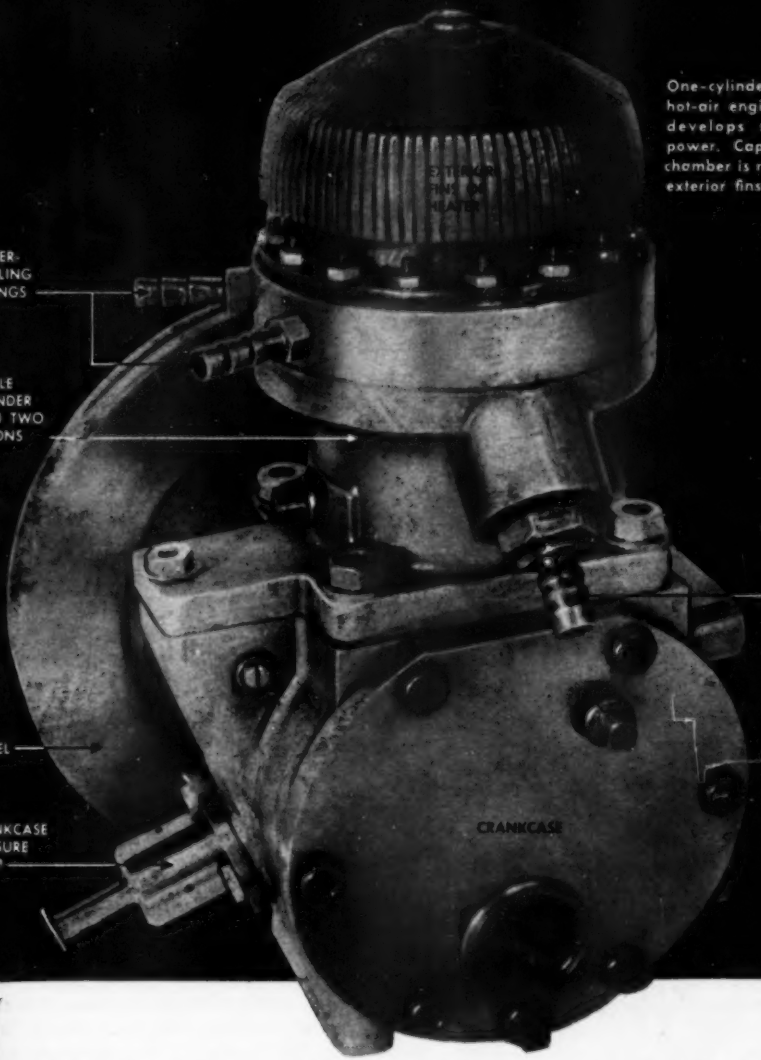


This solid steel disk (right), 26 inches in diameter, burst after being whirled at 11,700 r.p.m. One with a welded center came apart at 9,200 r.p.m.

Whirl Pit Tests Steel

How tough is steel? To find out, scientists put solid and welded steel disks in this armor-plate pit and spin them around at speeds up to 35,000 r.p.m.—or until they burst. As the disks whirl at such high speeds, the material actually flows out from the center toward the outside and thickens the edges; this is expected to provide valuable information on plastic flow.

In operation at the Massachusetts Institute of Technology under the sponsorship of the Engineering Foundation, the pit shown at left is 40 inches in diameter and nine feet deep. It is lined with lead pigs that preserve the disks for observation after they burst. A vacuum is created within the pit and the test disk is spun around by a flexible steel drive shaft; the vacuum prevents generation of heat as the plates are rotated and makes it possible to stop the whirling at any moment by letting in air. Another feature is that the machine can test materials at extremes of temperature.



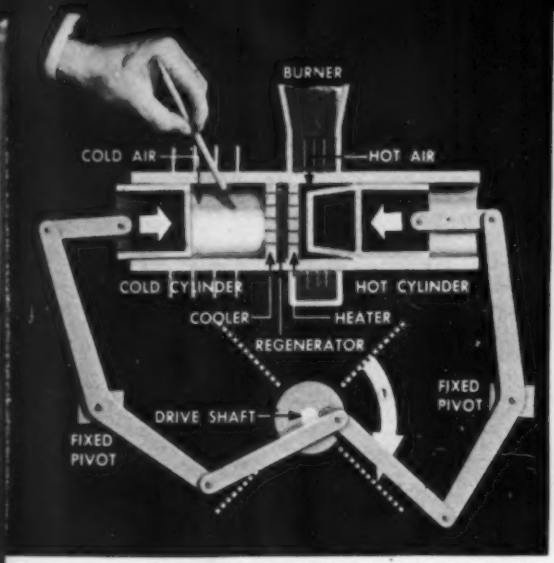
One-cylinder experimental hot-air engine of new type develops several horsepower. Cap of combustion chamber is removed to show exterior fins of heater.

Will the Old Hot-Air Engine Drive the New Cars?

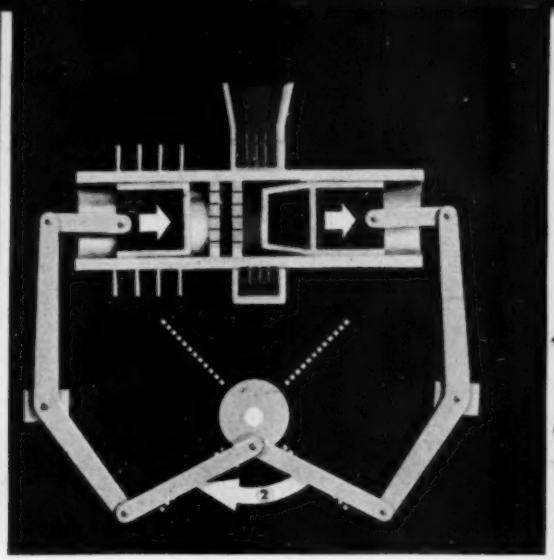
By Alden P. Armagnac

ARE hot-air engines, unsuccessful rivals of steam power a century ago, ready for a comeback? A streamline, 1948 version of an engine driven by expanding air, just announced by the Philips electrical works of Eindhoven, Holland, foreshadows that startling possibility.

A Scotch clergyman, Robert Stirling, devised its ancestors in the early 1800s. Thousands of hot-air engines came into use, in America as well as in England and France, for pumping water and other light tasks. Designs and available materials of those years, however, made the engines inefficient, slow, and bulky, and other forms of power eventually outmoded them. They seemed destined to remain a forgotten chapter in the history of mechanical progress. Then,

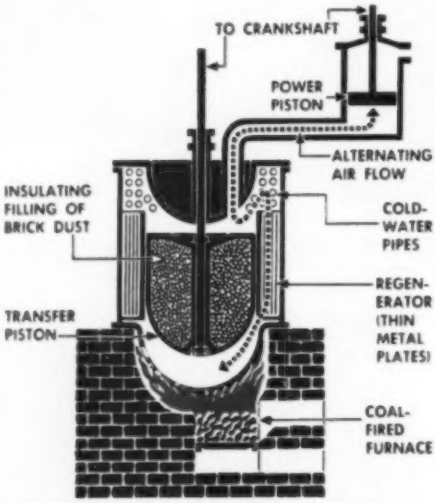


1. Compression stroke is first shown of four movements of Philips hot-air engine, demonstrated here by cutaway model. Short arrows show both pistons moving inward, compressing air mostly in "cold" space indicated, during travel of crankpin marked by curved arrow.



2. Transfer stroke now moves compressed air from cold cylinder to hot cylinder without change in volume, and air picks up heat from regenerator and heater. During this stage, both pistons travel from left to right, as will be seen by study of ingenious W-shaped linkage.

seeking a convenient source of power for radio sets in rural districts without electricity, Philips engineers became interested in the possibility of bringing the hot-air engine up to date—and fascinated by what they found modern design could do for it.



Pioneer hot-air engine. Stirling type of early 1800s, was this ponderous machine. Thousands of hot-air engines were built in the nineteenth century, but were superseded by other forms of power. Lightweight and efficient high-speed design now foreshadows their comeback.

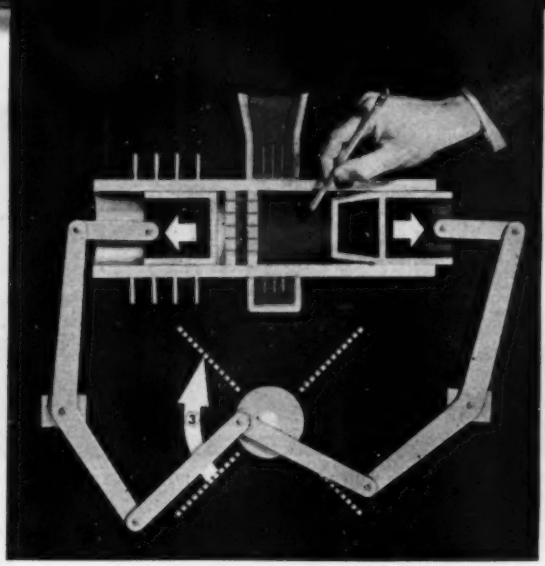
Today they have built and successfully tested models ranging from two to 15 horsepower, and plans for others up to several hundred horsepower are ready. Laboratory trials of the new types give performance figures that the producers themselves, at first, could hardly believe. For the modern hot-air engines, careful tests show, surpass gasoline engines and even approach Diesel engines in efficiency!

Hot-air engines for automobiles are made practicable by the new design, its sponsors declare. The smooth, cushioned power, in contrast to the impact of explosions in an internal-combustion engine, would simplify or perhaps dispense altogether with transmission gears. Another advantage would be long life, since absence of corrosive gases and extreme, high temperatures would minimize wear between pistons and cylinders.

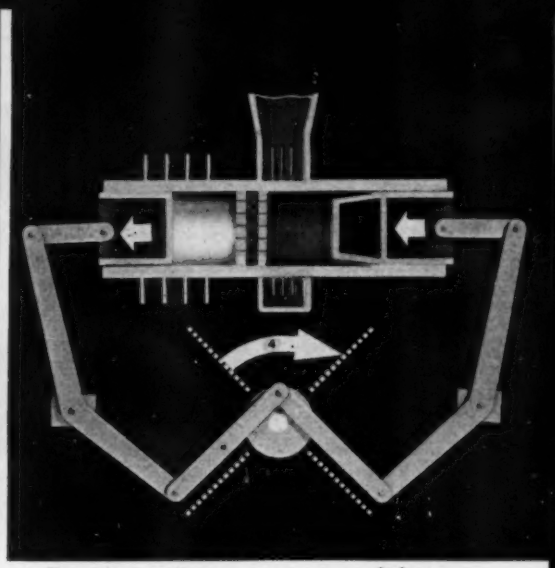
Other applications foreseen include electric generating plants for homes and perhaps for larger-scale power production.

To those who have watched it run, one of the most remarkable features of the Philips hot-air engine is its silence. It has no exhaust, no valves, no explosions in its cylinders. Hence a 15-horsepower hot-air engine, large enough to drive a small car, makes no more noise than a sewing machine.

Since it uses an external burner, instead



3. During power stroke, heated air expands, mostly in "hot" space indicated, driving both pistons outward. Amount of power delivered exceeds the amount consumed in other three movements of complete cycle, and the surplus represents the useful output of the hot-air engine.



4. Transfer stroke now moves expanded air, without change in volume, back to cold cylinder. Air gives up most of its heat to regenerator, rest to cooler. Then whole cycle begins again. First Philips engine was patterned after this model and ran successfully.

of igniting an explosive vapor in a cylinder, a hot-air engine isn't choosy about its fuel. It can run on gasoline, oil, gas, wood alcohol —practically anything that will burn.

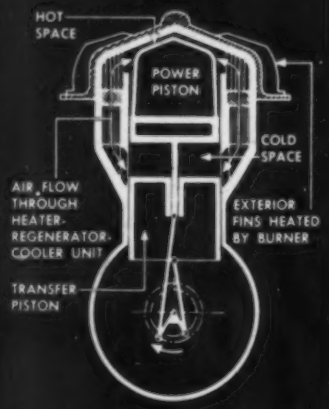
Just as new heat-resisting alloys made possible the development of jet engines for planes, they have been the principal factor in making hot-air engines practical. The elevated cylinder temperatures they permit have transformed the sluggish and ponderous hot-air engine of the nineteenth century into a compact, high-pressure, high-speed design turning up 3,000 revolutions per minute or more. With reduced size, heat losses can be more easily countered by insulation, lighter moving parts decrease friction, and efficiency improves all along the line.

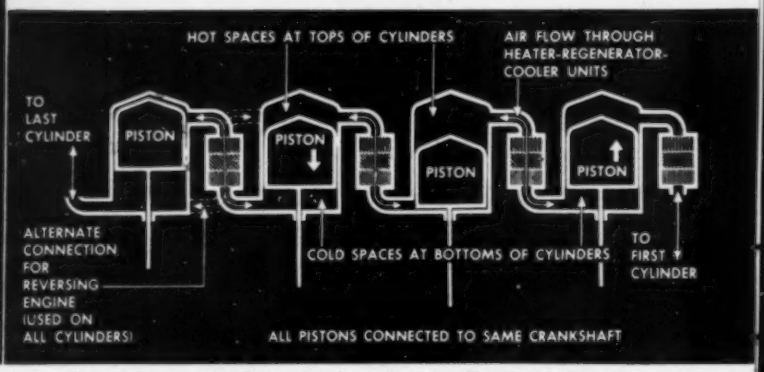
How Hot-Air Engine Works

Like steam engines, hot-air engines apply the fact that a heated gas will expand and furnish power. A steam engine uses heat to turn water to a gas, steam, and the expanding steam then drives a piston. Simplest of all prime movers, the hot-air engine uses heat directly to expand air, the gas that drives its piston.

In an ideal arrangement, heated air would be allowed to expand in a "hot cylinder," driving a piston and furnishing power to a flywheel and drive shaft. Next, the expanded air would be transferred to a "cold cylinder." Here another piston, driven by the flywheel, would compress the air to its original volume. Finally this air would be returned, without change in volume, to the hot cylinder and the cycle would start all over again. Because the pressure of the hot, expanding air is greater than that of the cooler air being compressed, the expansion stroke would yield more power than the compression stroke uses up. This net gain, resulting from heat input turned into mechanical energy, is the useful power delivered by the engine. No heat is lost in an exhaust, since the same air is used over and over again, shuttling back and forth between the two cylinders.

Actually, designers must compromise between an ideal form and a practical one. It is more feasible mechanically to let most, but not all, of the expansion take place in the hot cylinder; and to compress most, but not all, of the cool air in the cold cylinder. This can be done by arranging a pair of pistons so that the motion of one follows that of the other with a time lag or "phase difference" corresponding to about a quarter-revolution of the flywheel; it may vary a little, and need not be exactly 90°. With an experimental engine patterned after the model illustrated above, Philips engineers found that high efficiency could still be realized. The pictures show the four movements of



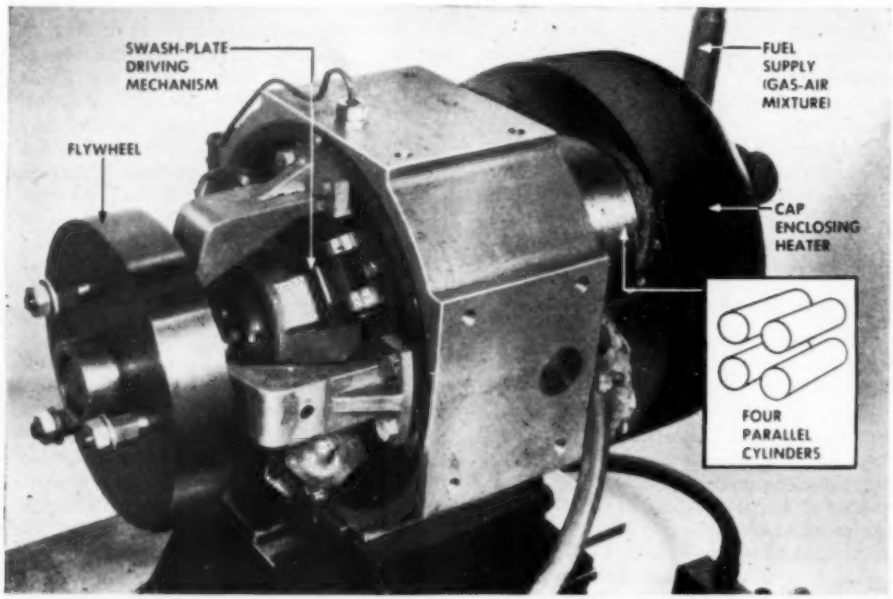


Simplified diagram at left, above, shows practical adaptation of hot-air principle in modern single-cylinder Philips engine. Two pistons operate within the same cylinder. Adding more cylinders actually makes the design simpler, as shown at right. One double-acting piston suffices in each of four cylinders, which may be grouped radially, in two Vs or in a square.

this elementary type of engine, beginning with the compression stroke.

Passing freely between hot and cold cylinders, air moved by the pistons alternately flows in opposite directions through the same passages of an assembly consisting of a heater, a cooler, and a regenerator.

The heater is a piece of aluminum bronze, an alloy that conducts heat well. It has exterior fins to pick up heat from the burner; and interior fins, forming a honeycombed passageway, that transmit this heat to air passing between them. The cooler is built almost exactly like the heater, with fins on the inside that remove heat from the air, and fins on the outside to be cooled either by air or by a water jacket. The regenerator, a thermal storage device designed to absorb heat almost instantaneously and give it up as quickly, is a porous mass of thin metal



Four-cylinder Philips hot-air engine, only 19 inches long over-all, develops 15 horsepower, enough to drive a small car. It turns up 3,000 r.p.m. and runs as quietly as a sewing machine.

wire between the heater and the cooler.

This "heat reservoir" has the important job of taking most of the heat out of the air as it passes from the hot cylinder to the cold cylinder, holding this heat momentarily, and then restoring the heat to the air as it returns from the cold cylinder to the hot cylinder. That leaves the cooler with much less work to do and prevents serious heat loss. A temperature of about 1,200° F. is maintained in the hot cylinder and 175° F. in the cold cylinder.

Following successful tests of their first engine, Philips experts have applied the same principle in improved designs.

A little one-cylinder model develops several horsepower. Its two pistons work in the same cylinder, part of which serves as the hot space and part as the cold space. An added refinement, not shown in the simplified diagram on the opposite page, is a pump that keeps air in the crankcase under the same pressure as that in the cylinder. This counterpressure obviates need for a tight-fitting piston to prevent air leakage past it, and also reduces bearing load. The effect on efficiency is so great that the engine's power can be controlled by an adjustment that varies the pumping rate.

Multicylinder Models

Multicylinder hot-air engines, instead of complicating the design, actually simplify it. When four cylinders using single pistons are suitably interconnected as shown in another diagram, a hot space at the top of each cylinder constantly exchanges the air it contains with a cold space at the bottom of the next cylinder. Each piston delivers power on its downstroke and acts as a compressor on its upstroke. The pistons have a 90° "phase difference." When No. 1 is at the top of its stroke, No. 2 is descending and delivering power, No. 3 is at the bottom of its stroke, and No. 4 is rising and compressing air.

For a good arrangement with short interconnecting passages, four cylinders may be arranged in radial fashion, grouped in two Vs, or set in a square. In the last type, suitable for up to 30 horsepower, pistons drive plungers acting against an inclined disk, called a swash plate, that turns the shaft.

The wide range of available designs emphasizes the variety of purposes to which the new engines may be adapted. Robert Stirling may yet take place with Robert Watt as a prophet of the Age of Power. END

By applying the principle of a hot-air engine in miniature, Joseph Tracy, a New York automotive engineer, provides the actual motive power for a model of a Diesel engine, above, that he has built. When a ring-shaped alcohol burner is attached as shown and lit, a pair of pistons begin operating, and the tiny flywheel spins merrily. A handsome example of precision craftsmanship, the model has a power cylinder of half-inch diameter and a one-inch stroke.

Applications of hot-air engines in recent years have been limited to driving models and toys and to stirring chemicals in laboratories, because of their low efficiency, slow speed, and bulkiness. "Even with these drawbacks," model-maker Tracy commented, "this principle is worth serious study. Possibly by the use of modern materials and scientific design, this type of engine might be vastly improved." As if to confirm his words, news of the efficient new hot-air engines described in the preceding article reached this country almost simultaneously.

Chemical Prevents Stocking Runs

NYLON runs will become less frequent when stockings are treated with Syton, a run preventive developed by the Monsanto Chemical Co. Syton also removes the shine from the surface of cotton, wool, and rayon fabrics, and makes them more durable and hard-wearing.

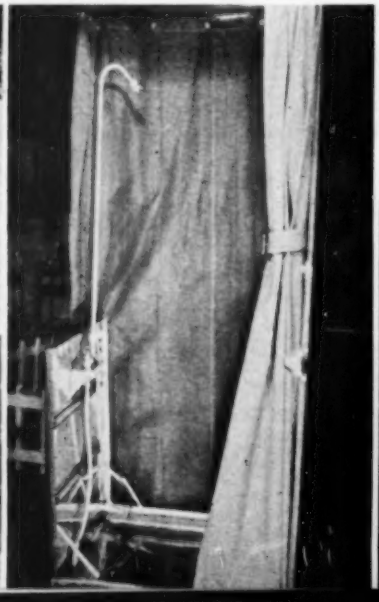
Built like an airplane, the Kit Companion trailer is said to be among the lightest riding jobs now on the market. In place of the usual frame with the body bolted to it, the Companion is made of light tubular steel formers to which the corrugated skin is riveted. Built in Long Beach, Calif., the trailer features a portable shower, shown in the three pictures below.

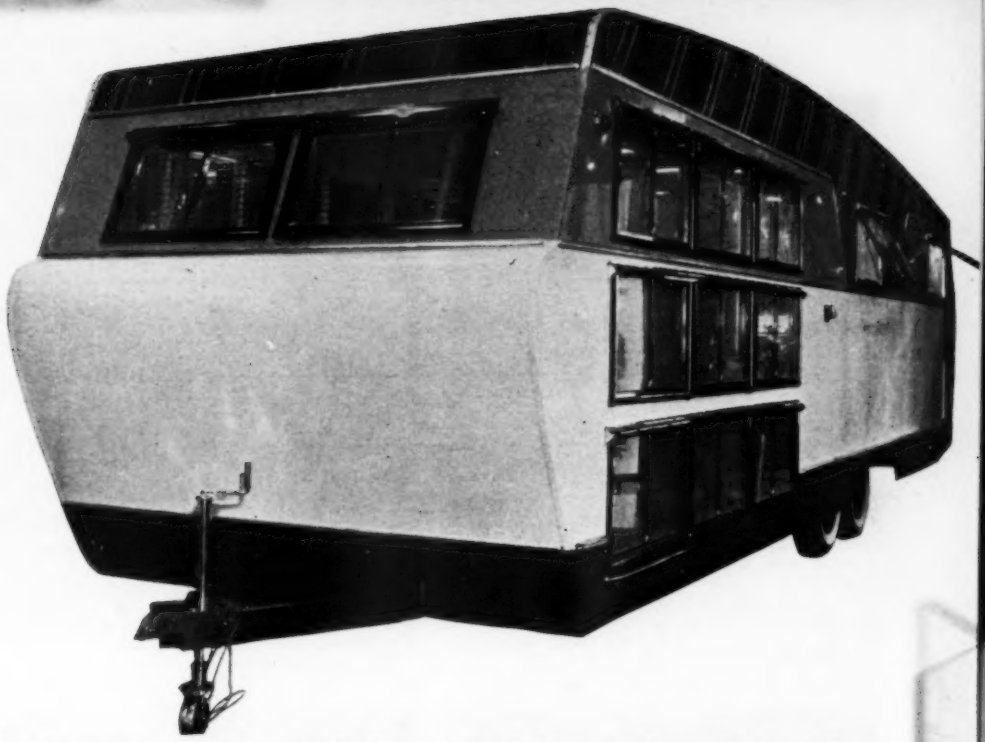
New Luxury En Route

Latest trailers feature apartment conveniences and comfort.

The doorstep below, at left, is really part of the Kit Companion's portable shower—and the awning doubles as a shower curtain. Packed away for traveling, the shower box is opened for use by lifting its top and pulling out the detachable piping system, center, below.

Hitch the hose connection to a water supply, pull around the shower curtain—and let her rip! Like a regular shower, the Companion's portable has faucets for either a hot or cold spray. The hot water is produced by an electric heater built into the trailer.

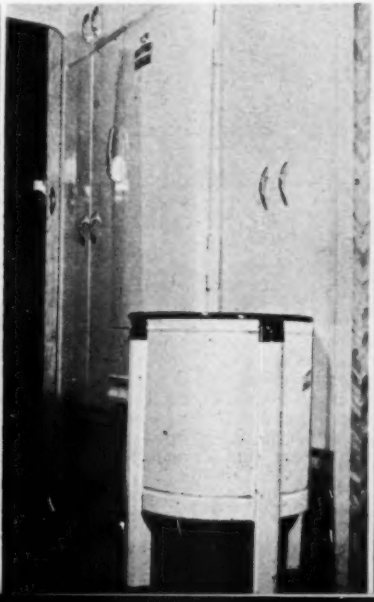




The Empress is a trailer for people who don't throw stones—almost half of it is glass. Behind the three-decker window panel are screens so that it can be opened up in summer without inviting wandering insects. In addition to a bathroom complete with a toilet and a stainless-steel stall shower, the Empress boasts a folding wall, shown below at right, that divides the living room into two bedrooms. The accordion screen is made of heavy, soundproof leatherette. The Empress is manufactured by the Duo Coach Corporation, of Chicago.

Here's a dinette table that unfolds from a kitchen cabinet. Made by Howard Industries, Inc., of Saginaw, Mich., it is shown below, left, with the table down. In the background are the cabinet's three rows of shelves that hold dishes or kitchenware. The table seats four persons.

A washing machine is fitted into the Homette, made by the Travelite Trailer Co., of Chicago. It is shown below, center, in a kitchen composed entirely of metal cabinets. The Homette also has an exhaust fan built into the ceiling and a water tank to provide a portable water supply.

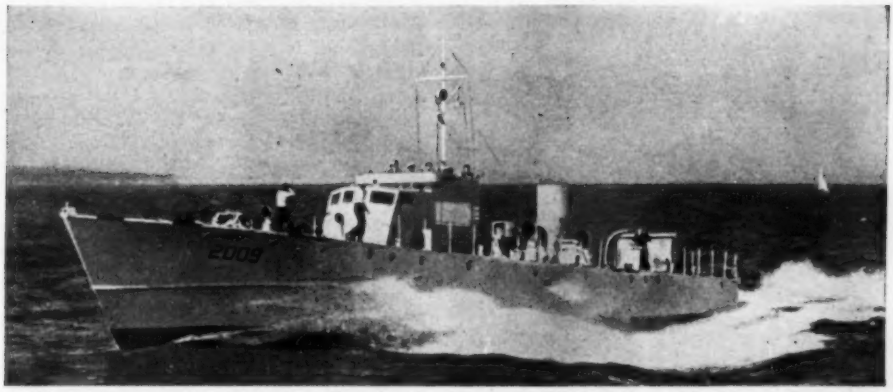


This gas heater is hidden away in the floor of the Nimrod trailer, made by the Nappanee Trailer Co., of Nappanee, Ind. The heater burns gas from a pressure tank carried at the front of the trailer and draws in clean air through the floor. Its use eliminates the usual ugly pipe stove in the trailer's living room.

A "fireplace" is the special feature made by the Platt Trailer Co., Inc., of Elkhart, Ind. The hearth is really a gas heater, fed by a tank. An exhaust fan installed directly above the heater unit circulates warm air throughout the trailer. The cabinets built in at either side of the heater can be used as bookcases.

A nursery is provided in this trailer so you can take the kids along. It not only includes this crib, but blue-and-pink lacquered furniture, a rocking chair for middle-of-the-night attention, a diaper hamper, and a bureau that pivots out to reveal a lavatory. They're all in the Schult Custom Aristocrat, from Elkhart, Ind.

This chest, shown at the Philadelphia Trailer Show, leads a double life. An ingenious piece of trailer furniture, it combines a bureau and a vanity table. The top drawer slides out, the top folds back to reveal a mirror on the underside—and here's a dressing table with plenty of room for cosmetics and toilet articles.

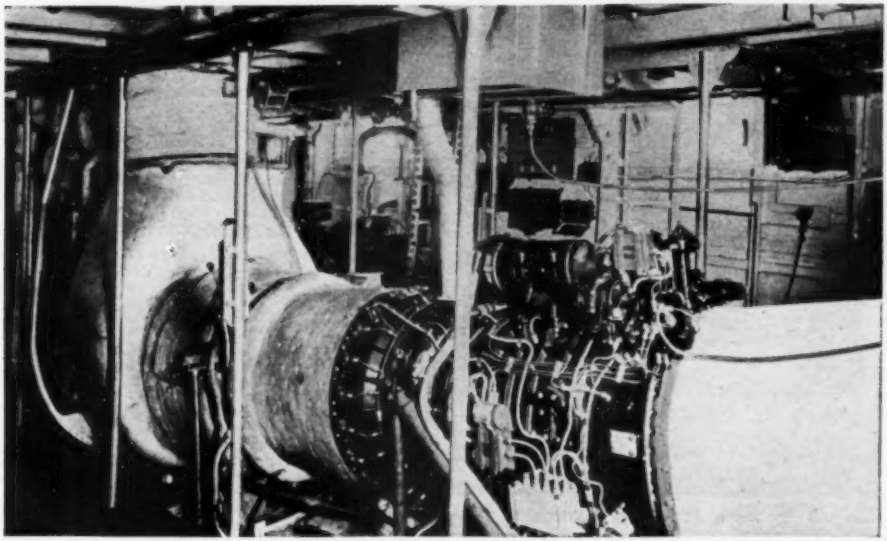


Stubby exhaust stack aft of the 2009's bridge is only visible evidence of her new power plant.

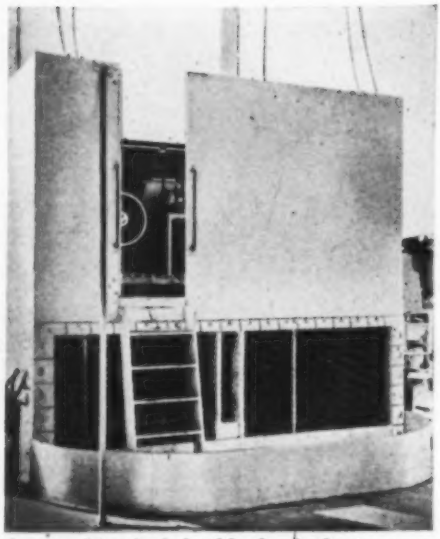
Air's Gas Turbine Goes to Sea

THE British Navy's MGB 2009 began life as just another 110-foot motor gunboat, her triple screws driven by three 1,250-horsepower Packard gasoline engines. Progress caught up with the 2009, however, and now she is undergoing sea trials as a brand-new kind of ship—the world's first naval vessel with gas-turbine propulsion.

Like many another maritime guinea pig, the experimental 2009 is a hybrid. Only one of her reciprocating engines has been replaced with a turbine; the other two still supply normal cruising and reverse power. The turbine itself is merely a modification of an axial-flow power plant originally developed for aircraft. But it turns out 2,500



From starboard, looking aft, turbine's exhaust is at far left; its white casing extends forward around power rotor and combustion chamber. Compressor section is left without a casing.

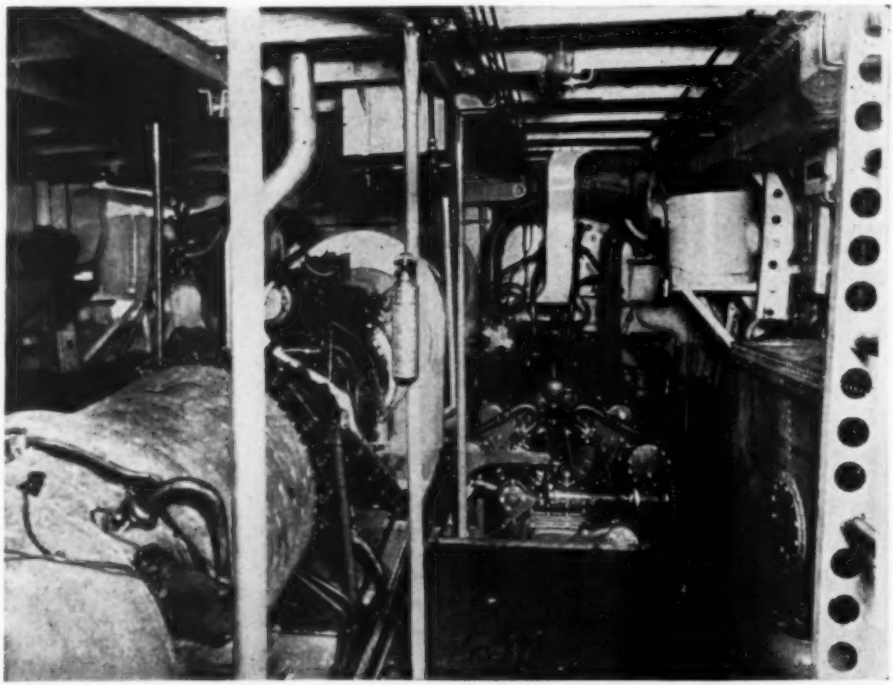


Screened intake behind bridge feeds nine-stage air compressor. After combustion, gas spins a two-stage rotor to power compressor; an independent four-stage rotor drives the propeller.

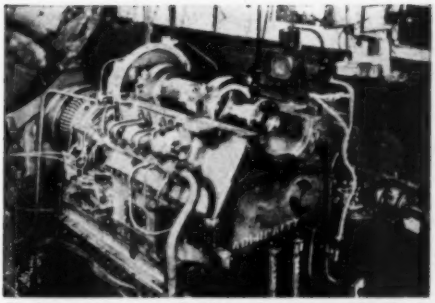
horsepower for full-speed-ahead maneuvers.

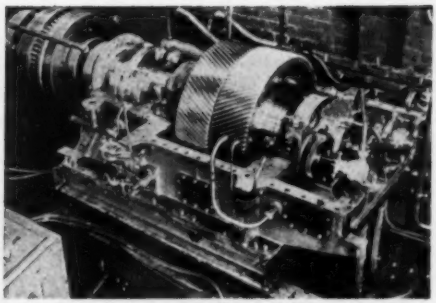
In testing the 2009, Royal Navy experts are not out to set speed records, although the new power plant has boosted the ship's speed from 30 to 34 knots. They are more interested in exploring the advantages of gas-turbine drive: more power per pound, ease of control, simplified maintenance, rapid acceleration, and, in large vessels, a saving of space. One limitation is greater fuel consumption, but the Admiralty has got around that by making the gas turbine a supplementary source of power, requiring fuel only for short periods. Using the original engines for reverse drive also dodged such problems as that of a reversible-pitch propeller; you can't make a high-speed turbine suddenly go backwards.

Finally, by employing the modified aircraft turbine, the Royal Navy got the jump on other marine engineers who have been working for several years to adapt the gas turbine for seagoing power. The U. S. Navy began a long-range experimental program more than three years ago. The U. S. Mari-



For all its bulk, shown by comparison with starboard reciprocating engine on its right, the turbine achieves a saving in pounds-per-horsepower. Geared independently to the 2009's center propeller, it remains idle except for full-power operation, when it matches the output of both piston engines together. In this view, the air intake is in the background.

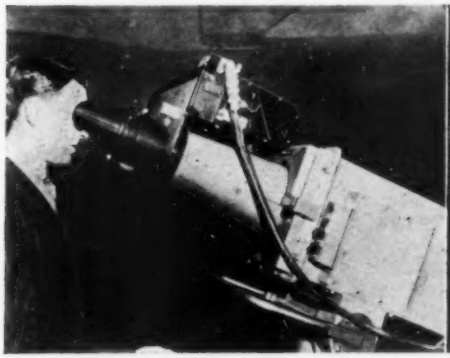


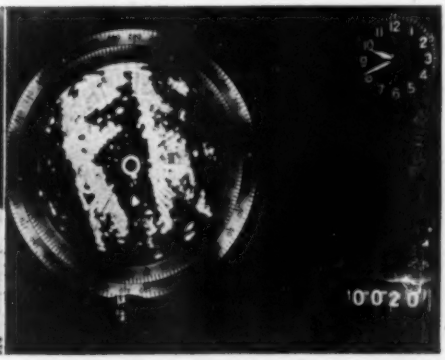


Reduction gears whittle turbine's speed, which tops 7,000 r.p.m. Turbine-driven pinion (above, left) at top of gear box transmits power to large main gear below it. Main gear, shown on right, turns the propeller. Self-synchronizing clutch links halves of double-helical main gear. Entire installation was designed by Metropolitan-Vickers, Ltd., of Manchester, Eng.

time Commission is fitting a Liberty-design cargo ship with a true marine gas turbine developed in 1945 by the Elliott Co., of Jeannette, Pa., but trials are still months away. In Britain, a 12,000-horsepower gas-turbine ferry is under construction.

With the 2009 already supplying experience in operation and control, the Admiralty is now planning larger gas turbines to power escort vessels. Designed from the start as marine units, they will be more efficient at sea than any converted aircraft version. But better turbines in bigger ships won't detract from the 2009's distinction: like Fulton's *Clermont*, she is a pioneer in a new field of power. END



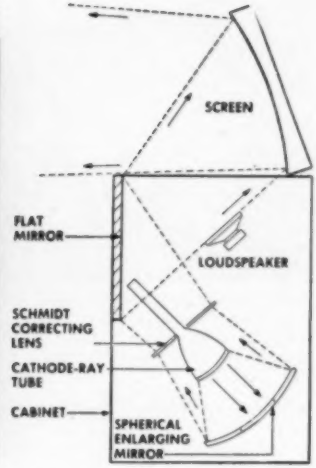


Making Radar Recollect

BESIDES telling a captain where his ship is in any kind of weather, radar can now tell him where it *was* at any moment of any trip. It can report today where and how fast the ship was going months or years before. In case of accident, it may even tell a maritime court who was to blame.

The trick of turning a flashing radar scope into a permanent record is done by the Fairchild Mirar (above, left), an automatic electric camera that can be set to snap pictures as often as conditions require—one every few minutes, or one for every flashing radar pulse. The camera uses 100-foot rolls of 35-mm. film with 1,600 exposures per roll, providing hours of recording even when the intervalometer, or timer, is set at a twice-a-minute rate.

The enlargement on the right shows how the camera gets its facts: besides the scope and its azimuth rings, which give the ship's course, each photo includes a clock face and a counter to identify it. With position and time known, speed can easily be computed from two or more pictures in sequence. Thus, when a roll is marked with dates and hours, it becomes a detailed, unalterable story of the vessel's performance.

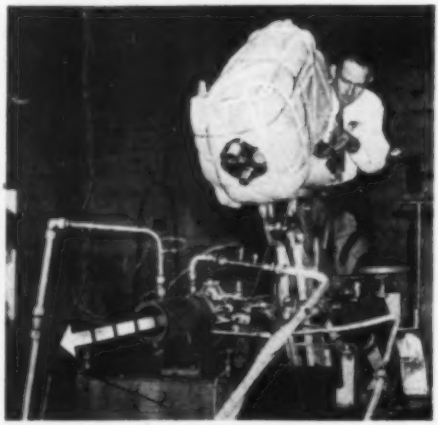


Tele Image Improved

EVEN with bright sunlight flooding the room, a sizable group can watch the 15- by 20-inch picture of the new Philco 2500 television receiver with perfect ease.

A spherical mirror (see schematic drawing above, right) enlarges the image as it reflects it through the Schmidt lens (which removes distortion) to the flat mirror and then to the concave metal viewing screen.

Vertical grooves in the screen brighten the image by concentrating most of the light into a beam that is fairly wide horizontally but narrow vertically. The usual dark spot in the center (caused by the tube blocking part of the image reflected back by the spherical mirror) is eliminated by spraying the screen with a clear lacquer that forms millions of tiny, lenslike droplets. These bend the light back to the center, giving an over-all brilliant image.

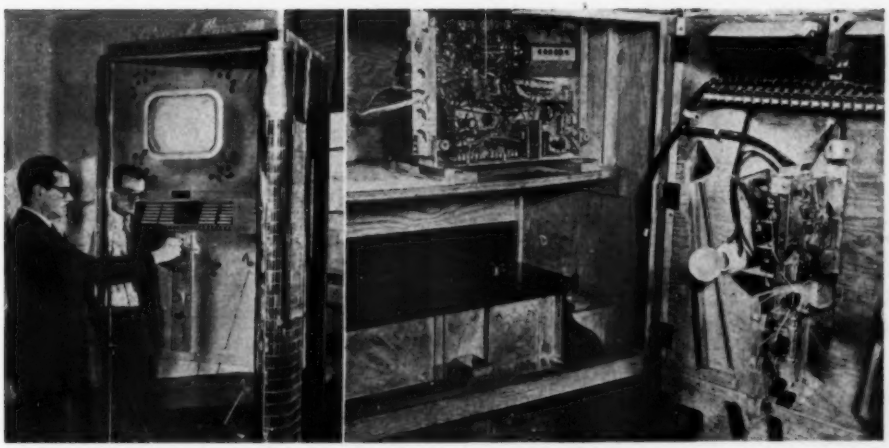


Rocket Tests Televised

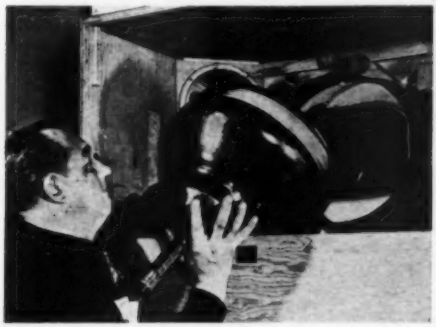
SWATHED in rubber to reduce vibration, a GE television camera is trained on the exhaust (arrow) of a high-thrust rocket motor. Scientists at Azusa, Calif., can thus observe the dangerous firing of the experimental rocket on tele screen 700 feet away.

For Germ-Killing Lamps

A GERMICIDAL lamp is swell for slaying bacteria in the air, but only if its lethal energy is up to par. Here's a new GE Wattmeter which, when placed in contact with a lamp as shown above, gives a direct reading of its germ-killing energy output. It is one of three such new meters put out by GE. Another measures the amount of germicidal energy reflected by walls and ceilings; the third measures the intensity of germicidal ultraviolet rays anywhere in a room.



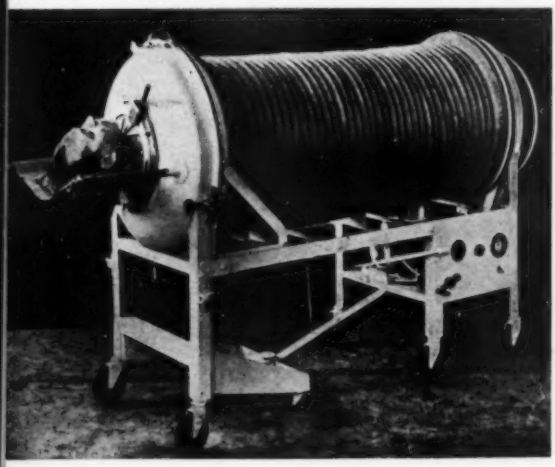
A nickel goes into the slot of a new television juke box, above, left. Screen is at top center. Picture above, right, shows how front opens for easy servicing. Phonograph turntable is at lower left, with television receiver directly above. Coin mechanism is on back of the door.



The big television viewing tube is replaced readily from the rear. Edge of one of the two speakers is partially visible above the tube.

Juke Box Gets New Look

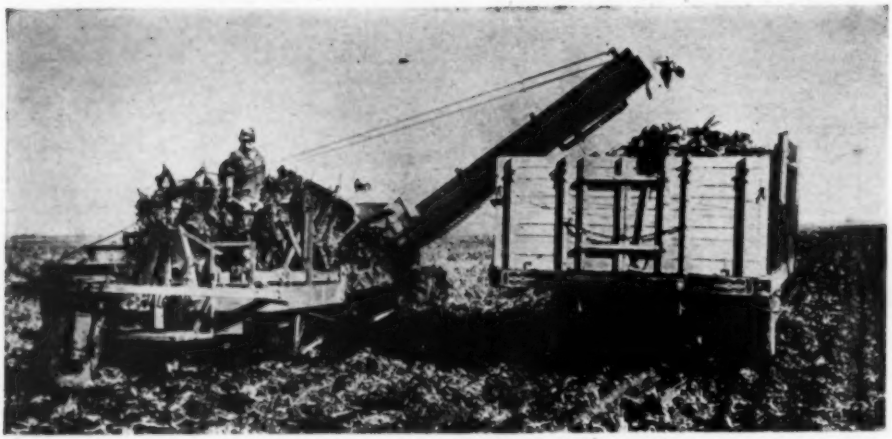
A NICKEL in the slot will buy you one televised prize-fight round if the neighborhood tavern is hep to the latest thing in juke boxes. This is a chrome-and-mirror-bedecked coin phonograph, made by the Videograph Corp., of New York, with a 12-inch television screen added. You can choose your own records in the usual way, but the manager decides whether your five cents will buy a three-minute glimpse of television. And since he operates the controls, he also picks the program. If jive, wrestling, and boxing fans are gathered in one place, he'd better be a Solomon.



Rubber Lung Folds Up

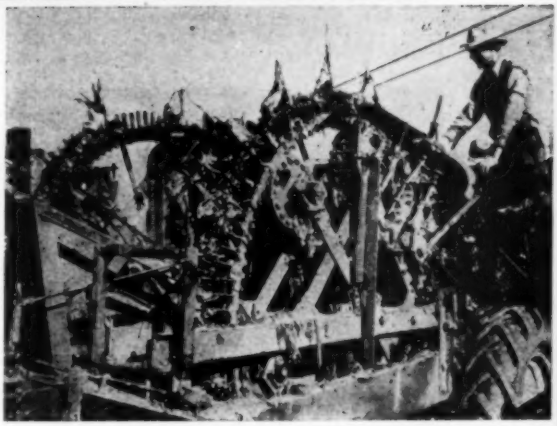
ONE drawback of the iron lung for emergency use is its great bulk and weight. Now the U. S. Rubber Co. and the Iron Lung Co. of America have come up with the lightweight, portable rubber lung shown at the left. A large accordionlike rubber bellows contains the patient, replacing the heavy steel tank of the iron lung. An electric pump forces air in and out of the chamber, enabling the patient to breathe.

When not in use the rubber bellows, which is reinforced by steel rings, folds up, as does the hinged base. Not intended as a substitute for the iron lung, the new respirator's principal feature is that it can be carried easily to the scene of an accident in a truck, ambulance, or plane.



Better Beet Harvester

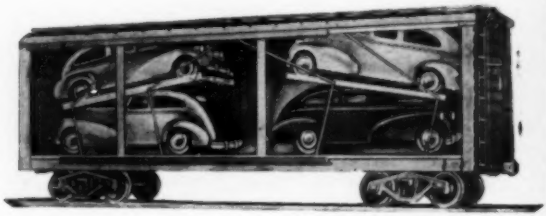
THE backbreaking job of pulling sugar beets has been taken over by a machine that does the work of 20 men. As the "harvall" moves down a row, plowlike lifters loosen the beets in the ground. Next come six-foot pronged wheels (right) that impale the individual beets. These are brought around to a point where a mechanism powered by the motor lifts the beets on the prongs to just the right height for cutting disks to slice off the top (crown and leaves) with a minimum of waste. The cropped beets go into a conveyer that dumps them into an accompanying truck. The machine is made by the Sterling Mfg. Co., of Minneapolis.



Autos Ride Piggy-Back

THE capacity of automobile freight cars is doubled by the use of a new loading rack, shown below. It stacks two autos in the formerly dead space at the top of the car.

For loading, the first automobile is rolled into the freight car and onto a lowered rack, which is then raised by an electric motor lift. A second rack at the other end is similarly loaded. Next the two floor autos are rolled into place, and the supporting legs of the racks let down and anchored. At destination, unloading takes four men 20 minutes. Made by the Evans Products Co., of Detroit, the system is used on all Atchison, Topeka and Santa Fe automobile freight cars.



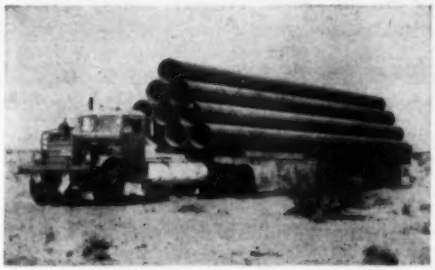
New Giant Trailers Plow Through Deepest Desert Sand

Desert maneuver for a load of 120-ft. pipe, weighing 36 tons. At rear is eight-wheel dolly.

MOTORIZED ships of the desert, trailers and trucks as sandworthy as camels, will haul pipe and supplies during construction of a new 1,050-mile oil line across an Arabian desert.

More than 300 units of trailer equipment, from eight-wheel, dual-axle pipe dollies to 3,500-gallon water tankers, were built for the purpose by the Fruehauf Trailer Co., of Los Angeles. Guinea pigs from among them were selected for "flotation," or buoyancy, tests among the sand dunes of the Arizona desert near Yuma. For the heavier loads of 36 tons or more, the big tires, as large as 14.00 by 20, were inflated to only 10 lb.; under other conditions, tire pressures were increased up to 25 lb.

The new pipe line, which will carry oil from the interior of Saudi Arabia to the Persian Gulf, is a $125,000,000 joint project of the Standard Oil Company of California and the Texas Oil Company.



Buoyancy of tires in deep sand is tested under varied conditions. Here tire pressure of 20 pounds easily handles a 32-ton load; other units will have to haul loads up to 100,000 pounds.

Rubber-mounted springs and fulcrum permit each of these massive tires to rise 18 inches above level and still maintain traction while rolling over rocks and other ground obstacles.

Refrigerator trailers like the one above are built of stainless steel to resist corrosion and reflect desert heat. Carrying 18 tons of food, they will supply the camps along the pipe line.

Don't Try to Crash This Gate!

Wall of security surrounds operation of Atomic Energy Commission.

By Frank Carey

Associated Press Science Writer

All lit up: U. S. Atomic Energy Commission's

ONE of the most beautiful nighttime sights in Washington is the U. S. Atomic Energy Commission's headquarters on Constitution Avenue. It's all lit up like a Hollywood theater—but for reasons of grim security, not display. This is protective lighting, designed to expose anyone who tries to break into the key building in the nation's atomic energy program.

A strong-arm force of 100 guards, trained in judo tactics and marksmanship, and a network of electronic devices and physical barriers make the building a bastion of security. And as the building itself is guarded, so are the secrets inside—from formulas to scientists' doodlings.

Less obvious than the floodlights, but constantly alert, are the electric "eyes" spotted all over the outside and on top of the building. According to security officials, anything "heavier than birds, hailstones, or leaves" will activate the eyes and flash a

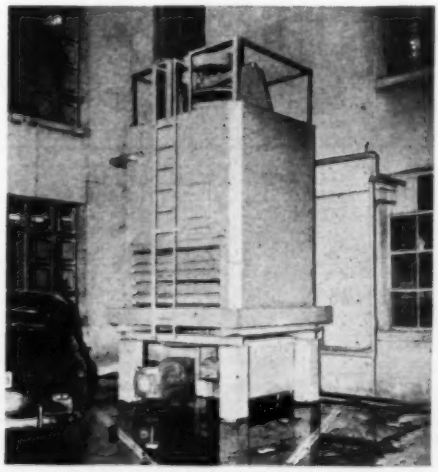
Grating being inspected above closes off possible hiding places where "dry moat" surrounding the building runs under stairways. One of the floodlights is seen at lower right.

Aluminum sheathing covers the wire mesh enclosures around the lower part of fire escapes. This is to foil any intruder who might try to gain entry by wearing spiked shoes.

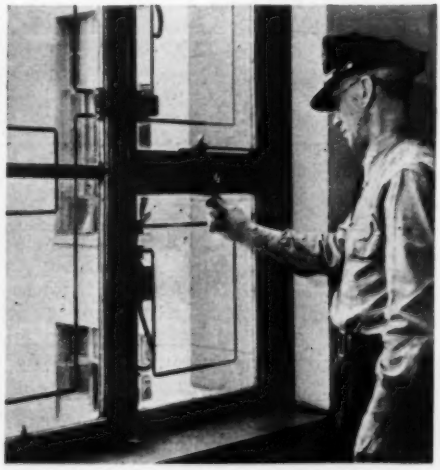
Washington, D. C., headquarters are brilliantly night-lighted to reveal possible prowlers.

signal on a centrally located enunciator board. Any tampering with the electrically protected windows will flash a similar alarm. In case of a break, it is estimated that guards could reach the farthest corner of the building's attic in less than two minutes.

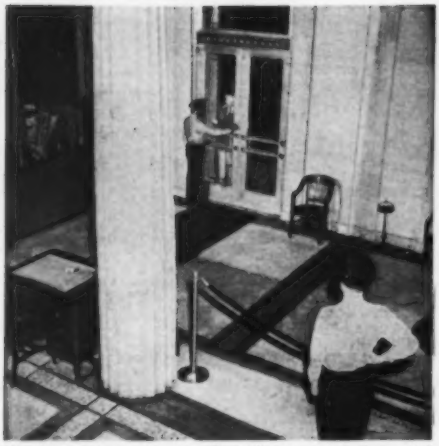
Even if you are an employee of AEC, and want to get into the building at night on official business, you find it no cinch. You show your identification pass to a guard on the other side of the glass panel of a door that is locked and hooked up with an electrical alarm system. You're okay, but the door guard, a cautious soul, looks at a semicircular mirror that gives him a six-angle view of the areas outside. If he doesn't spy a gang of potential enemy agents lurking offside, he signals another guard who momentarily switches off the alarm system so that the door can be opened. And then you finally enter, to be faced by a couple of stalwarts ready to draw guns from their



Air conditioners, linked with outside units like the one shown here, not only have electrical protection against prowlers, but contain filters designed to keep out poison gas.



Protective tape, carrying an electric current, lines every window accessible from the ground. Any tampering from the outside flashes a signal giving exact location of attempted break.



Night visitor shows identification at door. If he is okay, guard at far left will switch off door alarm system. As an added precaution, the guard in foreground is ready to draw his gun.

Both employees and visitors must check in at the reception desk to receive their badges. All visitors, except those on "preferred" list, must have an escort going to and from offices.

hip holsters—just in case you try anything.

When Bryan F. La Plante, a veteran of Army counterintelligence, took charge of the security system, he decided to start at the bottom. Right off he found that a man could gain entrance to AEC high-command offices by crawling through a heat tunnel linking the building with a central heating plant. When health authorities reported that a man could live in the tunnel for almost half an hour despite the heat radiating from the pipes, a concrete wall was built around the pipes.

Next La Plante recommended that seven of the nine entrances to the building be locked at all times, leaving only a single front and rear entrance open. The barred doors can be opened only from the inside by a five-door-type crash bar.

Now for legitimate entry into the building. Based on the system used at wartime installations of the Army's Manhattan District—makers of the A-bomb—regular employees have to exchange passes for badges at the reception desk. Both have a photograph of the "cleared" person, and these are carefully checked before a person receives his identification badge, which must be worn at all times within the building. When leaving the building, the employee turns in his badge and gets his pass back. As an extra precaution, the color scheme of all badges and passes is changed periodically.

Visitors must have an escort while going between offices and the reception desk, and even if they go out for a drink of water from a corridor bubbler. Exceptions are certain "preferred" list visitors. These include cabinet officers, congressmen, and scientists who have frequent business with the commission or its staff. They receive a special identification badge, but only after a thorough security investigation. And everyone, including David E. Lilienthal, Chairman of the Atomic Energy Commission, must "log in" at the reception desk. Only such clearance is the "open SESAME" to AEC's inner sanctums.

But even with everyone in the building checked and double-checked, the security staff doesn't relax its vigilance. Persons walking along corridors are frequently challenged and the photograph on their badges compared with the original. The prankster who pasted a picture of Hitler over his own identification photo and gained entry to a government building during the war, would soon get the bum's rush at AEC.

Some of our top scientists are doodlers from way back. So, after a pow-wow in one of the conference rooms—soundproofed against eavesdroppers—pads that have been used for making notes are carefully inspected. The security boys remove not only the sheets that have doodles or notes that may be of the slightest use to prying eyes, but also all sheets that have the slightest impression of a pencil mark.

Guards check every safe once an hour all through the night. If one is found open, the person responsible, whose name and

Badges of employees are placed in guarded racks when they leave, must be worn at all times while in the building. If anyone attempts to tamper with these badges, a "bleeding ink" flows and smears the surface. Bottom row of rack above holds badges of the atomic energy commissioners, with the one of Chairman David E. Lilienthal at the far right.

telephone number is pasted inside, gets a call. No matter what time of the night, he is told to hot foot it down and check the contents in case something is missing. And in the morning the culprit is on the carpet.

And although the building is fireproof, safes are so constructed that in case of a fire, they could crash through two floors without cracking open, holding their secrets intact.

Nothing "confidential" or higher is discussed over the telephone. And anyone succeeding in tapping a phone line is likely to hear a conversation interspersed with code words in a sort of glorified double-talk. Information is departmentalized—that is, employees are allowed to know all that is necessary for their particular job, but NO more.

This, of course, isn't a complete blueprint of the safeguards surrounding our atomic energy program. For, as La Plante says, "There's much more to maintaining security, but we can't tell all our trade secrets." END

No peeking. That's a regulation for guards dumping wastebaskets containing confidential and secret material that is to be destroyed. These special baskets are painted a vivid red.

This incinerator keeps its secrets well. The scraps of paper are burned to a powdery ash. Shoveled into trash cans, the ashes are then watered down to prevent spreading.

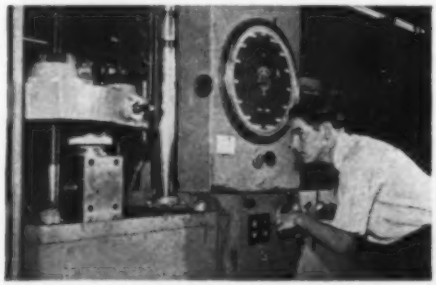
Freeze Treatment Hardens Soft Metal

Soft metal gets tough under a spray of liquid nitrogen that freezes it to 320° below zero.

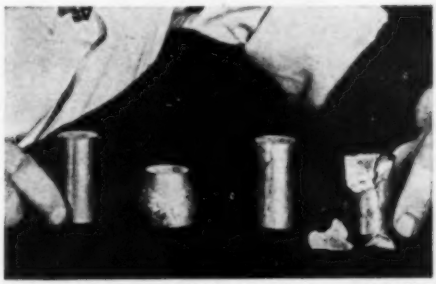
A METAL so soft that it melts in hot water can now be made to stand up under the tremendous pressures put on dies. A brief spraying of liquid nitrogen, one of the coldest substances known, does the job. In a few minutes, the soft metal, cerrobend, freezes and changes from a consistency like dried putty to the hardness of brass—and stays that way until it warms up again.

The treated metal, an alloy of bismuth, tin, and lead, was developed by Ford Motor Co. engineers for use as die material in making parts. Formerly it took six weeks or more to make steel dies. With the soft metal, dies can be made in a day or two.

Engineer arranges treated cerrobend dies in a press that will produce experimental metal stampings. From six to 10 stampings can be made between liquid nitrogen baths.

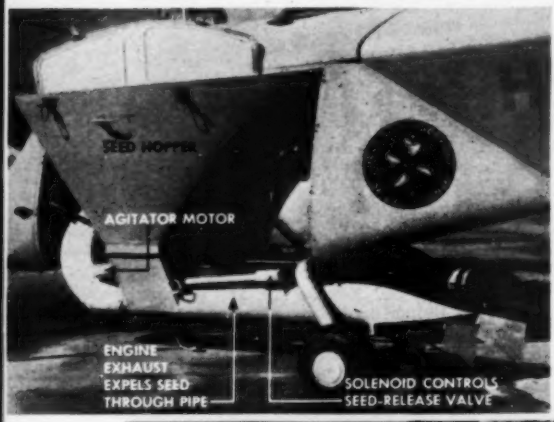


Load-testing mechanism is carefully lowered on the experimental dies. Although originally putty-soft, the metal is now hard enough to withstand a load of 10,000 pounds.



When nitrogen-chilled pig of the metal, far left, is subjected to a load of 5,650 pounds, it just bulges out. At far right is shown what happens to untreated metal under same pressure.

A seed-sowing helicopter spreads mustard over burned-out Los Angeles watershed to cover soil and forestall erosion. U. S. Forest Service photo below shows details of the sowing unit.



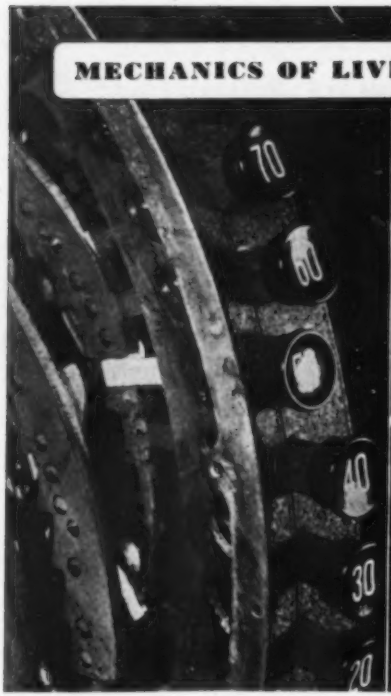
Helicopters Fight Erosion

IN California, they're sowing "dams" by air in the form of thousands of tiny yellow mustard seeds. Dropped by a pair of specially equipped, low-flying helicopters, the seeds take root quickly, checking surface-water runoff and promoting ground seepage. Use of the seed-sowing planes is an emergency move, directed by the U. S. Forest Service, to head off erosion of 1,000 fire-denuded acres of the Los Angeles watershed.

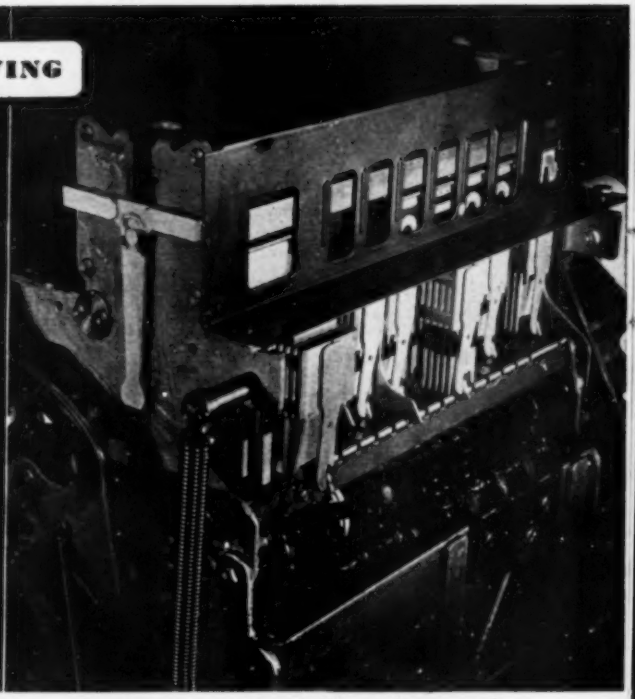
The Bell 48-B helicopters are each equipped with two seed hoppers. A power-driven agitator works the seed into the discharge pipe, where a 120-m.p.h. air blast from the engine's cooling system fans it out through finned openings. The down-wash from the helicopters' rotors drives the seeds into the ground and helps to keep them from being blown or washed away. At ground stations, observers check seed concentration in foot-square plots. Necessary changes in speed, altitude, or hopper openings are then radioed to the pilots.

Early test runs at altitudes as low as 30 feet ran seed concentrations up to 2,700 per square foot. By increasing the altitude to 100 feet and the speed to 60 m.p.h., and reducing the hopper openings, the ideal of 20 seeds per square foot was obtained.

Seed hoppers holding 200 pounds apiece are slung on outside of fuselage, one on each side.



Punching a cash register key sends a stem down to stop a gear wheel in the proper position. The gears move from the zero setting when the operating bar is pressed. In this picture, key stem and corresponding gear tooth are painted white and the key bank partly removed.



The gears move boxes holding indicator cards a distance that depends on the key punched, positioning proper cards under fingers on a rising bar (left, painted white). Fingers pick cards from boxes and lift them to windows. Notice "5" moving into view in window at top.

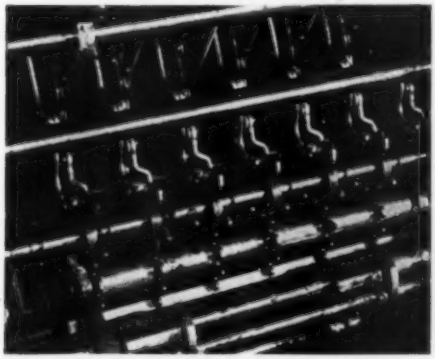
How a Cash Register Works

CASH registers have come a long way since James Ritty built the first one in 1879. His invention was simply a register and nothing else—the keys moved hands on a clocklike dial to indicate the amount of a sale. Now the modern machines do practically everything but tie up the package.

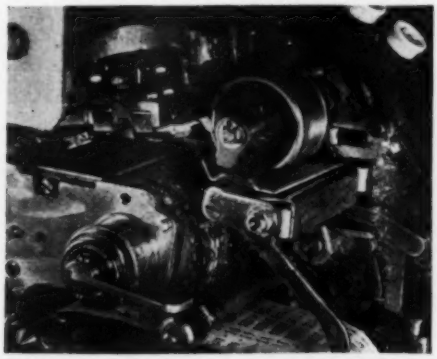
Some of the bigger models used in department stores have six cash drawers, a separate one for each of six clerks. Dials tell the manager how much each clerk has sold and how many sales he has made. Other dials keep track of payments made on credit accounts and petty cash paid out.

The National Cash Register Co.'s model shown in the photographs, a standard one used in many kinds of businesses, has one cash drawer and dials that count sales and total amounts. It prints a sales record, gives a receipt, and stamps the sales slip.

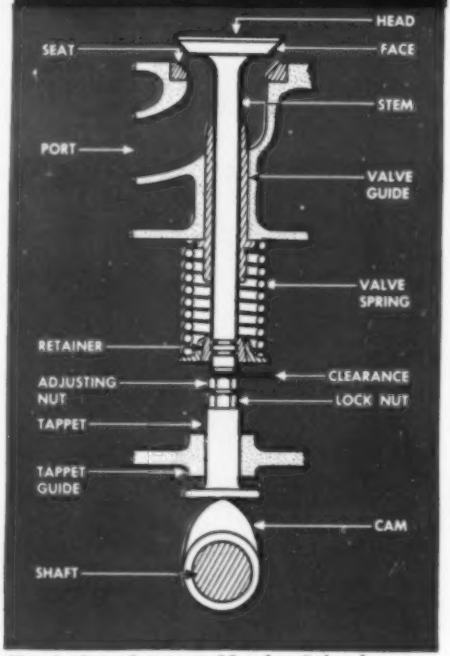
When all the gears and moving arms have finished their operations, the register shows a $5.00 sale. The center box shifted out to the "5" position while the other numeral boxes stayed at zero. The box at far left moved to locate the card indicating the transaction (cash) and the box at far right gave a card identifying the clerk. Actual movement of the indicator boxes is accomplished by the gears at bottom, which are connected to the gear wheels in the front of the register (shown in photo on other page). A small electric motor furnishes power.



The gear train shown above transmits information set up on the keys to the dials that tell how much money was taken in and paid out, and how many sales were made. This part of a cash register is essentially a standard mechanical adding machine. The merchant can also secure a printed record of the total day's business from some types of registers by pressing special keys when he checks up at closing time.



The printing part of this cash register makes a tape record of each sale (listing date, sale number, amount, type of transaction, and clerk), stamps the sales check, and turns out a separate receipt. The tape record can be seen at the bottom right of the picture and the printing wheel at lower center. This wheel has two sets of numbers to print record and receipt at once. Sales slip is then moved to stamping position.



Here's the valve assembly of an L-head engine. Valve seats are refaced as shown in the photo.

An Expert Tackles a Valve Job

By R. P. Stevenson

PSM photos by W. W. Morris

YOU can't drive a car forever without getting a carbon-and-valve job. Sooner or later, the engine begins to knock badly, idle roughly, or skip under load. Or perhaps a mechanic looks up from a compression gauge and tells you the compression is low in one or more cylinders.

When Model T's were stylish, lots of men did the job themselves, and it's still within the range of the man who likes to work on his own car. But in many ways, the job no longer is as simple as it once was. So, whether you are a hot man under the hood or turn the job over to a mechanic, you should know how an expert does it.

Your expert in this case is John Kowalski, who spends a great many of his working hours peering into cylinder blocks in the shop of James F. Waters, Inc., a company that operates one of the largest service garages in the East. These are pictures of an actual job performed on a 1941 Plymouth. The procedure may be considered typical for an L-head engine.

One thing you will notice is that the valves aren't ground against their seats; instead, every valve and seat is refaced. Because this can be done uniformly, the valves need not be kept in order.

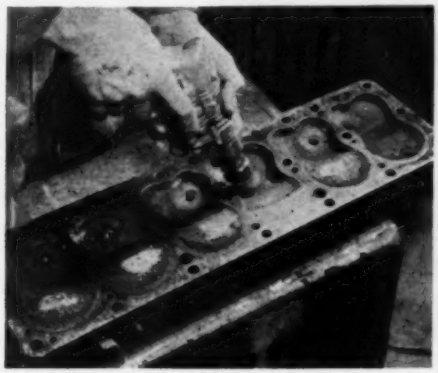
Although not shown in the sequence of photos, the mechanic also checks each valve spring with a spring-compression tester, discarding those that don't come up to a specified pressure. To keep the valves from sticking when the engine is first started, a drop or two of oil is placed on each stem before reassembly.

Along with a carbon-and-valve job, Plymouth factory policy specifies a complete engine tune-up. A working period of eight hours is allotted for the entire job.

1. A compression gauge hints that the job is needed, as a low reading suggests that a valve is sticking or burned. In this shop, compression is always tested as part of a regular tune-up.

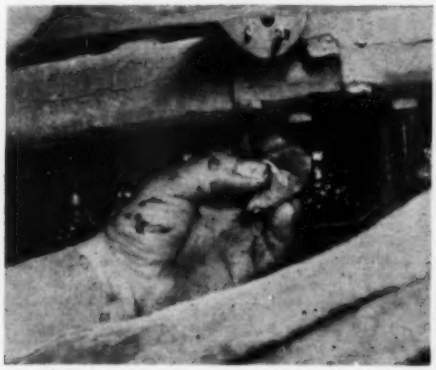
2. The job begins. To clear the way, the water is drained off, and the hose, air cleaner, oil filter, distributor, and wiring are removed or loosened. Then head bolts are removed as above.

3. As the head is lifted off for cleaning, carbon may be seen on the piston and valve heads. The mechanic gets a good grip on the head; even aluminum ones are awkward to handle.



4. Carbon is cleaned from the cylinder head with a wire brush chucked in a small electric drill. This step could be postponed until just before it is time to reinstall the head.

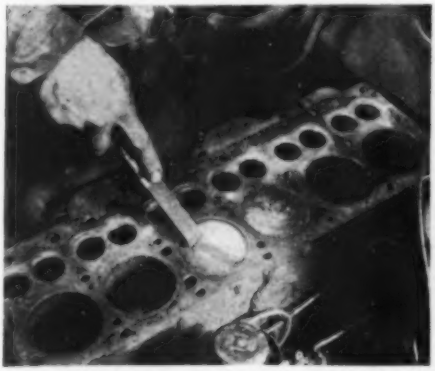
5. To reach the valves, the front is jacked up and the right wheel removed. Then the mechanic takes off the fender plate, heat shield, fuel line, and (above) side plates over the valves.



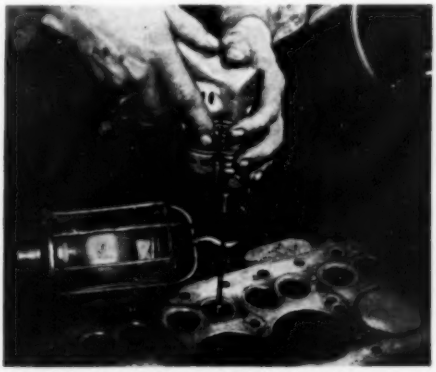
6. Oil-return openings near the tappets are plugged with cloth before the valves are touched. This keeps the small locking keys from falling into the crankcase. [*Turn the page.*]

7. Inserting a valve lifter, the mechanic now compresses the spring so that the keys may be removed. Before this, he checks to see that the valve is in the down position; that is, closed.

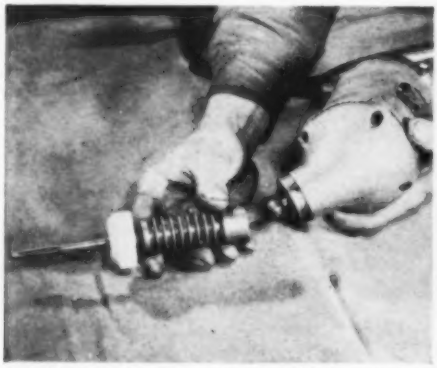
8. Using a mallet, he taps the valve head after it has been raised by the lifter. This loosens the keys for removal. Unless it is stuck, the valve can now be lifted out with the fingers.



9. Carbon is scraped from the piston heads and the entire upper surface of the block when all valves have been removed. The mechanic works carefully to keep scrapings out of the bore.



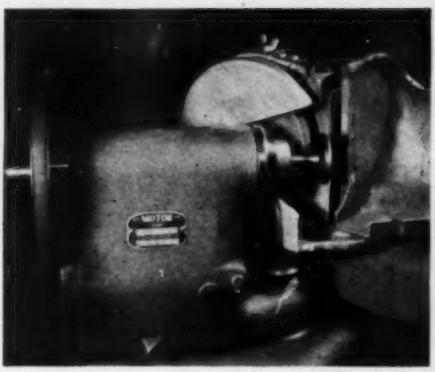
10. All valve guides are cleaned with a reamer chucked in the ever-handy drill. Sometimes, a guide is worn so much that it must be replaced. Note the clean block after the carbon removal.



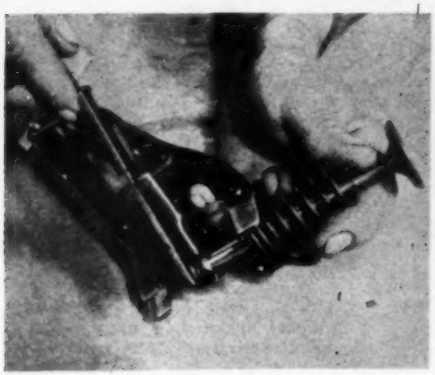
11. Valve seats are refaced with this grinding tool, shown in use on page 168. The protruding stem keeps the stone and seat in proper relationship. The grinder has a 45-deg. face.

12. Since the seats must be refaced at exactly 45 deg., the cutting stone is dressed from time to time in this way. In some cars, for instance the Pontiac, the valves are seated at 30 deg.

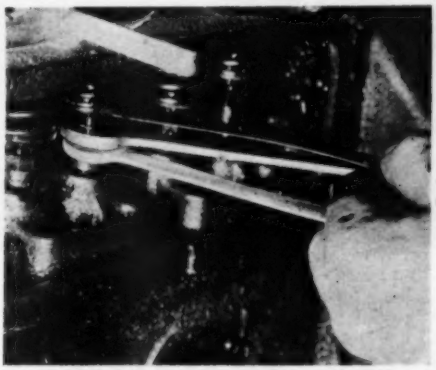
13. Valves are cleaned with a power brush in a machine shop adjoining the garage floor. The carbon quickly comes off and the metal of the head, face, and stem is left bright and shiny.



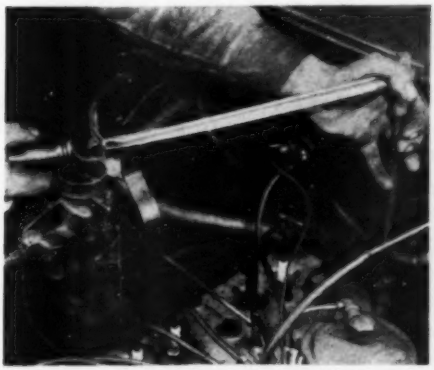
14. Valve refacing is next. Each is mounted so its face contacts the grinding wheel at 45 deg. Valve and wheel revolve in opposite directions. The ends of the stems are also faced off square.



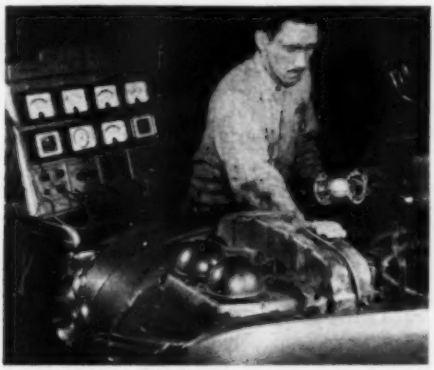
15. Valves are installed with a lifter and key inserter. When the lifter is removed, spring tension forces the retainer down over the two small keys, locking them in place on the stem.



16. Setting the clearance is an exacting step. With one wrench on the lock nut and another on the adjusting nut, a feeler gauge does the job. Here, intake clearance is .006", exhaust .008".



17. A torque wrench sets the head bolts at the proper tension as the final step. New gaskets are installed, of course, before the head and valve-cover plates are returned to place.



18. When the job's complete, a motor analyzer gives the car a checkup before release to the customer. It tests compression, timing, setting of the points, and carburetor adjustment.

From the back of his car, Kiskum exhumed an easel, a canvas, and a palette, and went quickly to work.

Gus Wilson and the Deepee

The little artist had no money, but he had a smooth tongue and a problem Gus knew how to solve.

By Martin Bunn

"HERE stands Kiskum."

Mrs. Miller giggled, and Gus Wilson turned to stare at the man unexpectedly there beside them. They saw a little fellow dressed in paint-smeared corduroy pants, a threadbare shirt—also paint-specked—and a velvet ribbon that was twisted into a flaring bow around his neck.

"So what?" said Gus.

The visitor jabbed the end of a long index finger into his chest. "Kiskum—me! The lady will permit that I resume the chapeau?" He bowed in the direction of Mrs. Miller. Flashing a likable smile, he pulled on a

stained blue beret. "Here stands Kiskum. You, meestair?"

"My name's Wilson." Gus laughed.

Kiskum grabbed his hand and pumped it vigorously. "Pleestameetcha! You geeve me a wranch, heh?"

"Why should I give you a wrench?"

"I geeve heem back queek."

"Oh—that's different," Gus said. "What kind of wrench?"

"A munkey wranch." Kiskum's fast-moving hands measured off eight inches of air. "Like so."

Gus got him the tool. Kiskum bowed to Mrs. Miller and marched to the door.

"Such an *odd* character!" gushed Mrs. Miller.

Gus sadly surveyed the ruin that Mrs. Miller had made of a good automobile engine and got back to the diagnosis that Kiskum's arrival had interrupted. "I'm afraid you'll have to leave your car here till tomorrow," he announced.

Stan, who had gone outside, barged back into the shop. "That guy's got the floor boards up and he's taking off the cover of his transmission—with our wrench! Whatd'ya think of *that* for nerve!"

Gus laughed and went to the door. Mrs. Miller and Stan followed.

Muttering to himself, Kiskum was working on his car—an old one which had obviously had a hard life as well as a long one. He straightened up when he saw Gus. "I feex heem myself," he said hastily. "I got no kesh. I am a deepee."

"You're a what?" Gus demanded.

"A deepee," he repeated. "What you call a displeased person."

"Oh," Gus said sympathetically, "A displaced person. That's tough. Did the war—"

Kiskum shook his head violently. "It is not the war which has displeased me. It is my landlord. I got no kesh. He displeases me on the sidewalk. So!"

Gus smothered a grin. "That's tough, too. What are you going to do now?"

Kiskum's expressive hands sketched a wide gesture. "I trevel," he declared. "But my car it goes only in the slow motion." The man yanked at the gearshift lever. "He stick in the low gear. So!"

Gus nodded. "How long has the gearshift been stuck?"

Kiskum shrugged his shoulders. "Since I start to trevel this morning. Before that —two, three months."

"Do you mean to say," Gus demanded, "that you've been driving in low gear for two or or three months?"

"I feex heem," Kiskum explained, "but he don't stay that way. When he stick the first time, I go to the garage. The mechanician say my transmission got to be overhauled. I got kesh. I have it done. Two weeks more, he stick again. The mechanician say my transmission got to be—how you say it—rebushed. I got no kesh, so I drive in slow motion to the lot where I stand my car. I take off the transmission cover and look inside. When I put it back it works fine. But it sticks again. Every three times I drive I feex heem once."

Gus rubbed his chin. "I'll take a look."

"I got no kesh," Kiskum warned.

"I didn't say I'd fix it for you," Gus replied gruffly. "I just want to look."

It didn't take him long to find out what was wrong. The shifting rods were loose in the transmission case—the bushings in which they rested had worn sloppy. As a result, the end of the shift lever could climb out of its notch in one position. When this happened, both lever and rod jammed fast.

"It can be fixed," Gus told Kiskum, "but it would be rather expensive to do it properly."

"I got no kesh," Kiskum said glumly. His face brightened. "I propose to you a swap. You feex my car—I paint your peecture."

"An artist!" Mrs. Miller gurgled.

"I am what you call a helluvagood artist," Kiskum said with dignity. "I show you." He reached into the back of his car and yanked out large paintings and small ones which he propped in a row against the shop's wall. Mrs. Miller greeted each addition with a squeal of delight. He made a final trip to his car and came back with a portait of an unwholesome-looking old man with a cockeyed leer and a hobo beard. "My mesterpiece!" he told Gus proudly. "You feex my car, I paint you like heem. So?"

Gus had made up his mind that while this might be Art, he preferred the curvatious nifties on the shop calendar. "No soap," he said with finality.

Mrs. Miller had been digging frantically into her recollections of six women's club lectures on art appreciation. Now she came up with the word she had succeeded in remembering—she wasn't sure what it meant, but she isn't one to fuss about the meaning of a word so long as it sounds impressive. She gazed soulfully at the picture of the unprepossessing old man. "Beautiful—oh, beautiful!" she breathed. "What *chiaroscuro!*"

Kiskum went slowly over to her. "Madam permits?" Mrs. Miller giggled. He took her well-rounded cheeks between his palms and gently tilted her head. "Ah, yes—charming!" He turned briskly back to Gus. "You feex my car—I paint your lady. So?"

Highly delighted, Mrs. Miller started flustered explanations. Stan snickered. Gus grinned. "Well—O.K.," he said. "Help Stan push your bus into the shop."

Kiskum did. Then from the back seat he exhumed an easel, a canvas, and a palette. With the businesslike air of a man whose time is valuable he carried the shop's only chair over to a window, posed Mrs. Miller in it, and went to work.

So did Gus. He started by lighting his pipe while he stared thoughtfully at the exposed transmission. Then he drew out the gearshift lever and examined both the pivot ball and the end that engaged the notches in the shifting rods. "Seems to me," he told Stan, "all we have to do is get the lever to ride about three thirty-seconds lower."

"Sure," Stan assented. "All you have to do is weld on that much metal, grind it to the right shape, and case-harden it."

"Is that the only fix you can think of, son?" Gus asked.

"Heck, no! We could put in a new transmission or rebush the old one," here he lowered his voice to make sure it wouldn't carry beyond Gus's ears, "but I don't think Mrs. Miller's picture'll be worth that much to you—except maybe to hide a hole in the wall!"

His employer laughed and shook his head. "Try again, youngster. You're missing at least two good bets."

Stan pursed his lips, squinted, and assumed an expression of deep concentration. "Well, if you could take three thirty-seconds off the bell bottom—"

"Now you're getting there," Gus assented. "And you wouldn't even have to take off that much." He peeled off the gasket and measured its thickness. "One thirty-second. You'd only have to take off another sixteenth if you left out the gasket."

Stan nodded vigorously. "That's pretty neat, boss. Want me to do it?"

"Pretty optimistic, aren't you? It's no cinch to chuck that housing in the lathe."

"But you said. . ."

"I said that was one way. There's an easier way still."

"O.K." Stan let his shoulders slump with a defeated air. "I give up. You tell me."

"The pivot, of course. Take off the right amount of metal from the bottom of the pivot ball, and the lever will move down. Let's go."

With Stan watching, Gus applied a blowtorch to the bend of the shift lever, straightened it, chucked it in the lathe, and carefully turned a fraction of an inch off the ball. Then he rebent the lever.

"That should do it," he said. "You carry on, Stan."

Leaving Stan to his job, Gus walked across the shop. Kiskum looked up, "You feex my car?"

"It'll be ready to roll in a minute."

The artist brushed in a dozen swift strokes. "Completed—done!" He jumped up and bowed to Mrs. Miller. Almost before Stan could replace the floor boards, he had tossed his equipment into the car, hopped in after it, started the engine, and shifted gears. "Ah! I am out of the slow motion! Now I trevel!" The old engine roared; he waved his hand and drove out.

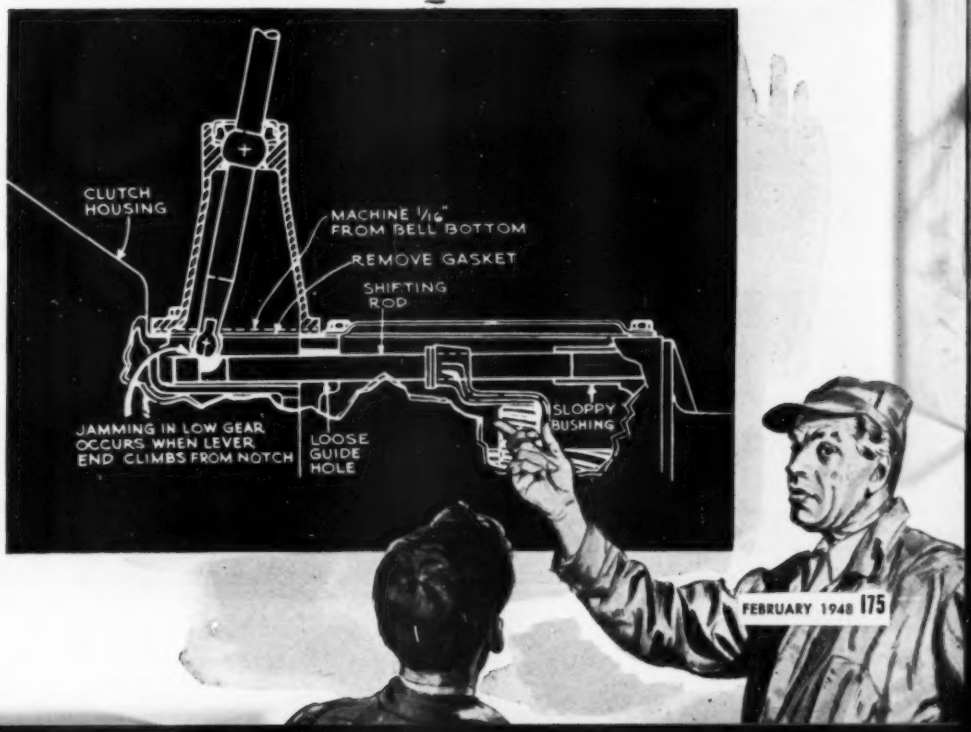
Mrs. Miller hurried over to look at her portrait. Her figure is generously upholstered, and Kiskum's brush had painted what his eyes had seen. From the canvas a fat, goggle-eyed woman stared back at Mrs. Miller. Her face reddened with rage. "I don't look like *that!*" she shrilled. Then she tried to smile. "Only, of course, it's Art! I'll hang it in the living room—yes, over the fireplace." Doubt assailed her again. "But I *don't* know what Henry will say!"

She floundered out, taking the still-wet picture.

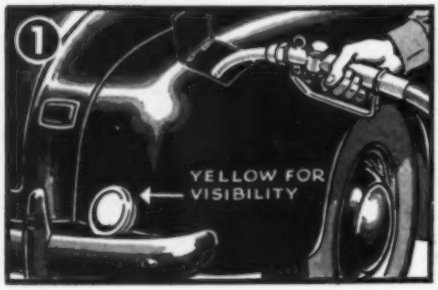
"I know what Henry'll say," Stan suggested, " 'When does the balloon go up?'—that's what! Lookit here, boss—I don't get it, the way we fixed that gearshift. We never did the job that way before."

"That's right—we didn't," Gus admitted, "but we never did the job on a car that was as badly treated as that one. A dentist doesn't put a gold inlay in a tooth he's going to yank. Kiskum's car has another year or two at most, so we gave him a quick, cheap, easy job that will work fine for at least that long. We saved time and money, Kiskum got a job that's plenty good enough, and Mrs. Miller got a portrait that's so much like her it hurts. You figure out who got the worst of the deal." END

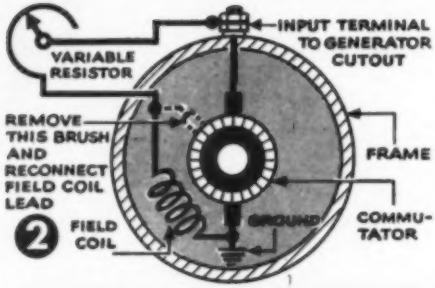
For Other Useful Auto Hints From the Model Garage, Turn the Page.



Hints From the

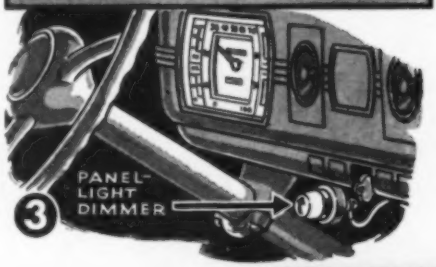


1. Watch Your Cap! Doc Kennedy drove into the Model Garage a couple of weeks ago and yelled for Stan Hicks to fill up his tank. Next day Doc turned up again, and accused Stan of forgetting to put the cap on the tank. Perhaps Stan did. Anyway, it was lost beyond doubt. W. Van Sandt, Long Branch, N. J., thinks grease monkeys like Stan would be less likely to overlook the cap if it were painted bright yellow for contrast. A good idea for the oil filler cap, too.



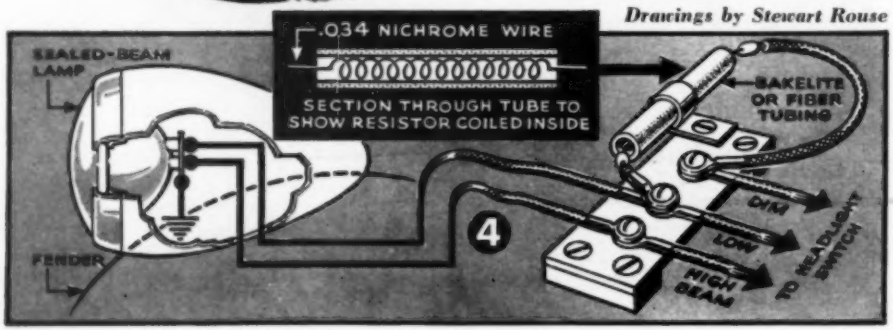
2. Vary the Voltage by Hand. When extra electrical accessories are installed, a problem always arises if the car lacks an automatic voltage control. If the generator is set to carry the extra load, it's apt to overcharge the battery when the load is off. As a solution, K. C. Anderson, Ames, Iowa, installed a manually operated field resistor rated at 100 watts, 5 ohms. The resistor was placed on the dash, and generator output can now be varied while driving.

3. Less Light on the Dash. If your car doesn't have a dash-light dimmer, a variable resistance switch from an old car heater will let you adjust the brilliance of the instrument-panel lights. J. R. Sisley, Seattle, makes the suggestion.



4. Parking Lamp Improvised. While installing several sealed-beam adapters, Henry J. Stauf, of Woodside, N. Y., found that the low beam could be dimmed for use as a parking lamp by placing a 1-ohm

Drawings by Stewart Rouse



Model Garage

resistor across the dim and low beam connections from the light switch. He used .034" Nichrome ⓣ wire to make resistors.

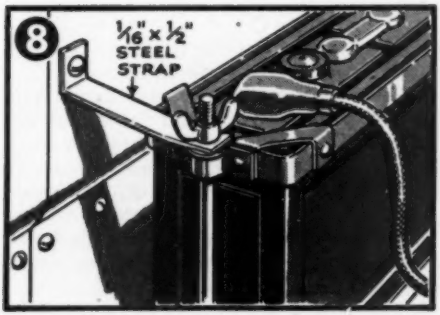
5. X Marks the Puncture. In a tire shop where he once worked, writes Fred C. Daley, of Oklahoma City, an indelible pencil was used to mark tube punctures, two lines being crossed at the pinhole. Then, after the tube was buffed for patching, the ends of the lines pointed toward the pinhole.

6. Aluminum Dresses Up Car. One reader has replaced scuffed and broken inside panels with sheet-aluminum ones, using sheet-metal screws. A little buffing gives a chromelike appearance.

7. Emergency Fuel Pump. If you believe in preparing for trouble before it occurs, here's an idea. Should your fuel pump go bad, a spare gas-tank cap with an inner-tube valve soldered to a hole drilled in its center will enable you to pump enough gas to the carburetor to reach a repair shop. Just a few strokes are enough for several miles, according to H. W. Mills, of Albion, Ill., who has found the idea practical.

8. Bracket Steadies Battery. Vibration, the enemy of any car battery, can be lessened in under-hood installations by bolting a strap-iron bracket to the fender apron and the battery hold-down bolt. The idea comes from Glenn A. Wagner, of Delmar, N. Y.

Gus Wilson



Builds Own Station Wagon

MOUNTED on a jeep chassis, this station-wagon body is the work of Bruce N. Thompson, of Seattle, Wash. The body was framed with hardwood and finished with birch paneling. Safety glass was used for all windows, and a full length upholstered seat in front increases the riding comfort. A scale model was built first.

A 14″ extension was bolted to the rear of the chassis, allowing a longer body and providing space for a rear gas tank. The spare tire is attached to the hinged tailgate so that when the latter is opened the tire drops out of the way. An old windshield was used for the top part of the rear door.

For trim on the sides, surplus aircraft tubing was sawed in half. This also conceals the body bolts.—MIKE CLARY.

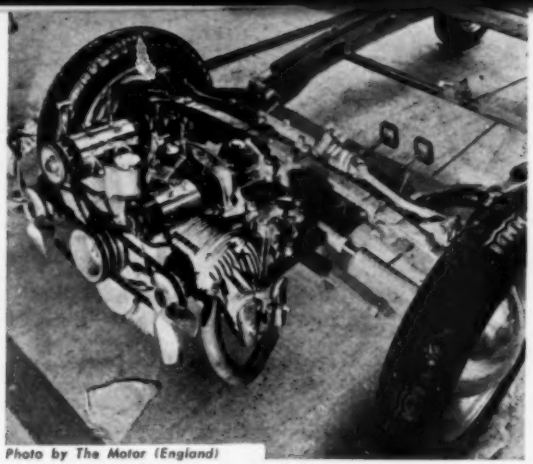


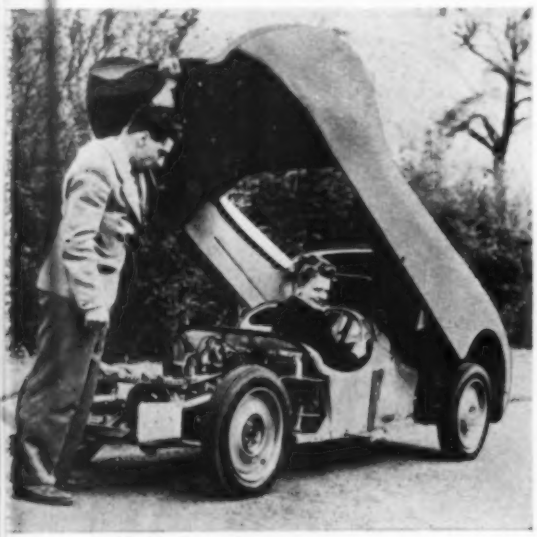
Photo by The Motor (England)

Engine Mounted Ahead of Axle

IN THE small French Dyna-Panhard car, the engine and four-speed transmission are located ahead of the axle and the driven front wheels, leaving the entire wheelbase available for passenger accommodation. The engine is a flat twin of 24 hp., air cooled by two fans placed in front.

Although the wheelbase is only 7′ and the tread 4′, the forward location of the engine and the lack of a propeller shaft make it possible to use a body that will carry four persons comfortably. The overall length of the car is 11′ 9″. Aluminum construction keeps the weight down to only a little more than 1,000 lb.

A similar motor-mounting arrangement is found in two other European cars, the Czech Skoda Minor and French Gregoire.



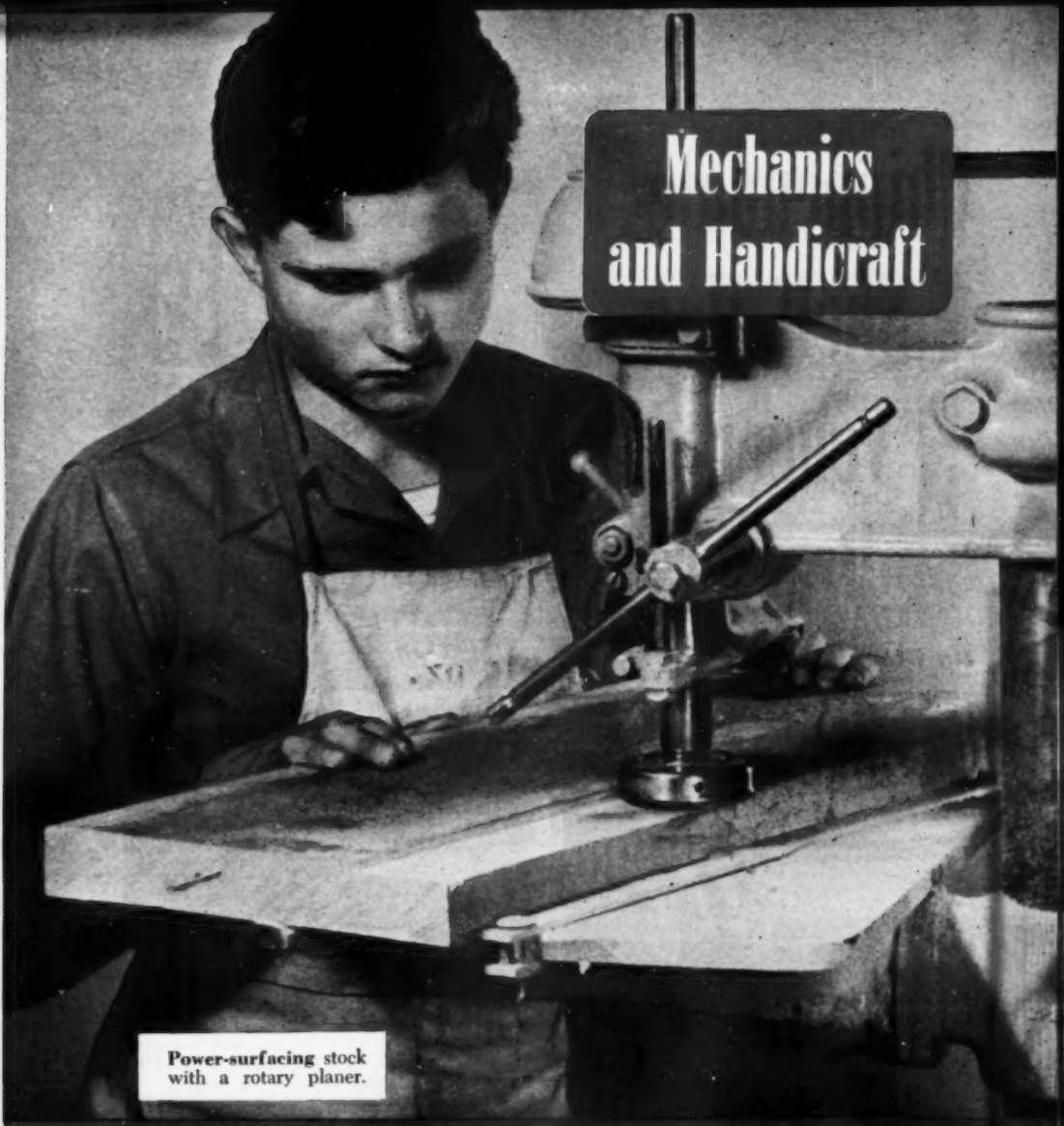
Body Lifts to Uncover Engine

IF YOU should want to service the engine of a small British car, you'd have to lift the entire body, instead of just the hood. However, this would not be difficult, for the car is small and the streamlined body shell, hinged at the front, is made of lightweight materials. Release of one catch at the rear allows it to be raised.

The car is a Cooper Special, developed from a racing model that has turned in some good performances in British trials.

Powered by a two-cylinder motorcycle engine located at the rear, the car attains speeds of 75 to 80 m.p.h. and travels about 65 miles on a gallon of gasoline. There are three speeds forward and one in reverse, transverse springing is used on all wheels, and ahead of the two-person seat are found the fuel tank, spare wheel, and an air intake to help cool the rear engine.

Mechanics and Handicraft



Power-surfacing stock with a rotary planer.

Surfacing with Power Tools PAGE 190

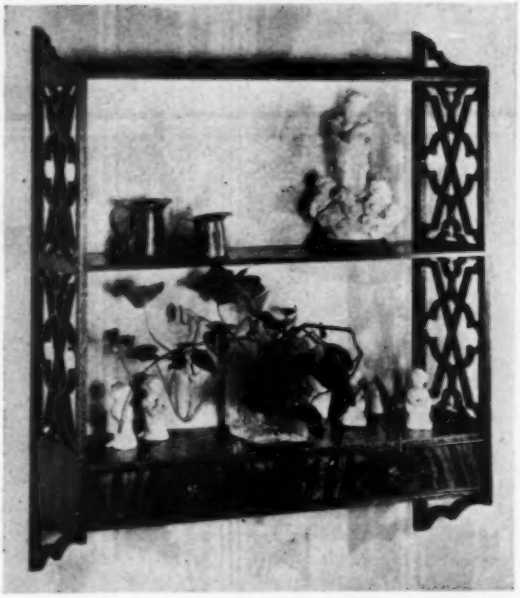
Chippendale Wall Shelf PAGE 189

Magic with Neon Glow Lamps PAGE 192

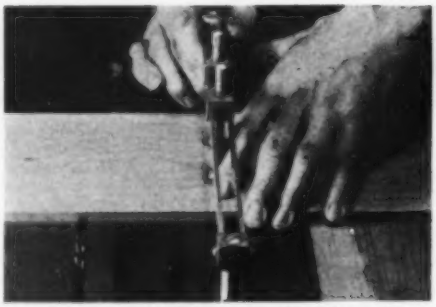
Jigsaw Head for Hand Grinder PAGE 207

Short-Wave Converter Gets DX PAGE 218

Chippendale Shelf Has Veneered Drawers

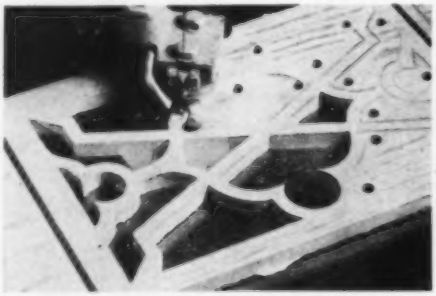


By Glenn A. Wagner

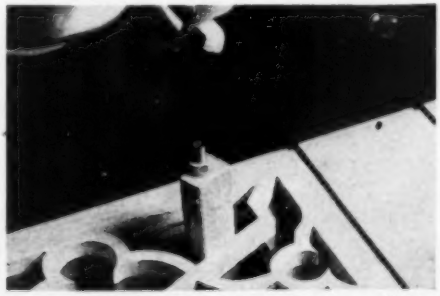


1. Cut ⅛" by ¼" dadoes in the sides and two bottom shelves with a circular saw, as above, or with a ¼" bit in a hand router. Lay out the dadoes with the pieces clamped together.

2. Trace the fretwork pattern directly on the side pieces with a wood or cardboard template. Before doing this, it is advisable to sand all surfaces of the sides and the four shelves.



3. Bore holes in the waste to allow insertion of the blade, and, in sawing, split the line. Heavy paper attached to the underside of each piece with rubber cement will prevent chipping.



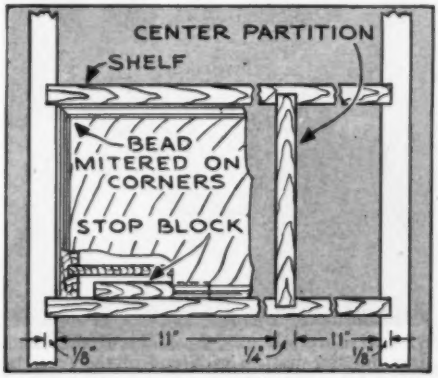
4. Sand the fretwork edges, being careful to get into corners. After a final sanding of all faces, glue together the sides, shelves, and the partition. For the drawers, see page 182.

MOUNTED above a spinet or slant-top desk, this wall rack will be a period piece you can be proud of. Since the fretwork pattern was taken from Chippendale's book of design, mahogany is the most appropriate wood to use, although cherry will serve very well. Solid wood, rather than plywood, is suggested, but in either case the drawer fronts should be veneered with crotch mahogany and edged with a decorative bead strip.

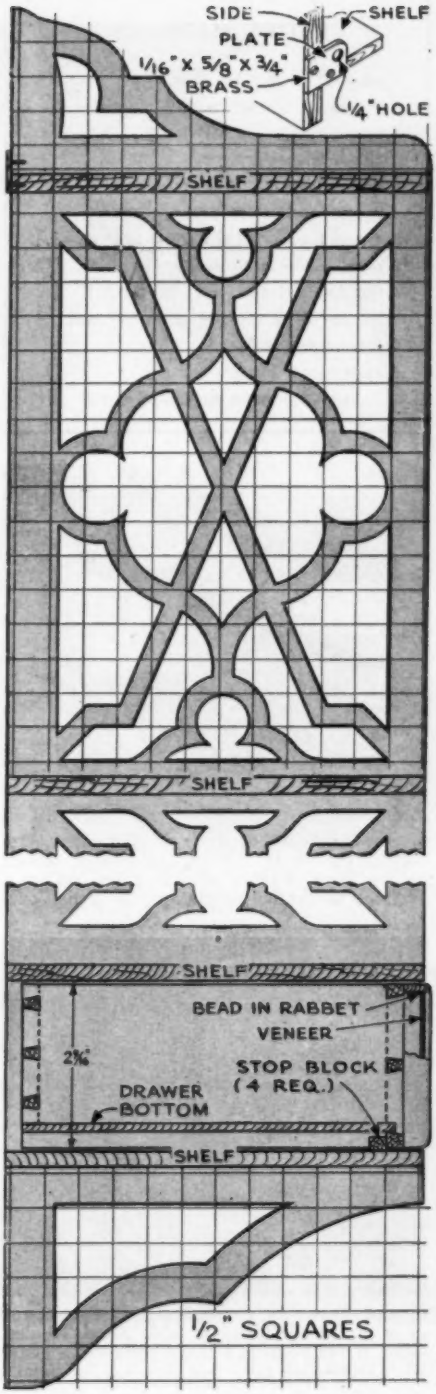
To lay out the dovetails, set a marking gauge with a knife-edge pin to the thickness of a side and then scribe lines on each side of both ends of the back and sidepieces and on the back and end of the drawer fronts. A bevel square set for a slope of 1" in 6" may be used in marking the sides of the tails. After cutting the tails in a sidepiece, this may then be used as a template to scribe lines for the pins on the end of the mating piece.

When the rack is complete and thoroughly sanded, sponge with water to raise any loose wood fibers. Sand again when dry, apply stain, allow to dry, apply a coat of linseed oil and turpentine, half and half, and allow to dry for several days. This treatment will give the wood a rich color. Next, a very thin coat of orange shellac may be applied, followed by two coats of rubbing varnish, each coat being sanded smooth before the next is applied. As the final step, rub the last coat with pumice stone and lemon oil, or apply lemon-oil furniture polish and rub down with rottenstone and oil. Use a felt block for the rubbing.

Finally, attach two brass pulls to the drawers and make and attach two hanger plates as indicated in the drawing.



The two drawers of the rack are separated by a partition dadoed between the bottom shelves.

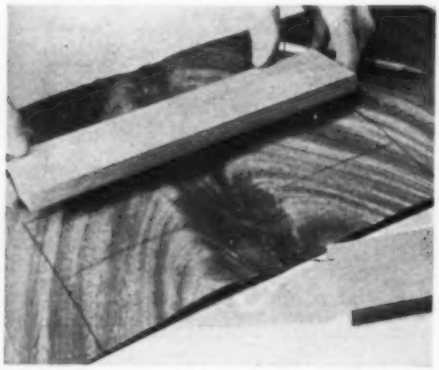


LIST OF MATERIALS

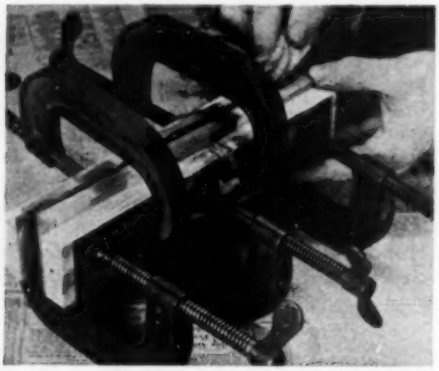
2 sides ⅝" by 6¼" by 27½".
4 shelves ¼" by 6¼" by 22½".
1 center strip ¼" by 6¼" by 2 13/16".
2 drawer fronts ½" by 2½" by 11".
2 drawer backs ¼" by 2¼" by 11".
4 drawer sides ¼" by 2½" by 5¾".
2 drawer bottoms ⅛" by 5⅝" by 10¾" plywood.
2 pieces veneer to fit drawer fronts.
4 stop blocks 3/16" by ¼" by 1½".
5/32" by 13/32" beading about 60" long.
2 brass drawer pulls.
2 brass hanger plates.

(All dimensions are finished sizes).

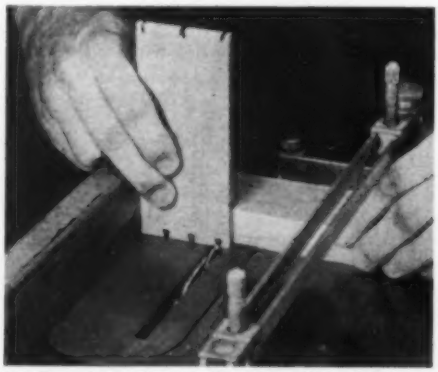
5. Begin the drawers by fitting fronts to the openings, leaving 1/32" clearance at the top and one end. Make backs that match the fronts and cut the endpieces to the same height.



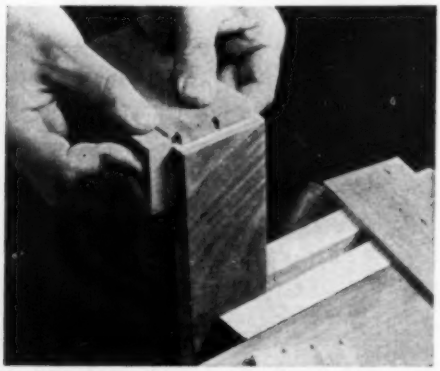
6. Apply veneer to the drawer fronts before cutting the joints. Center the veneer pattern on the front, making allowance for trimming. Wet the veneer before gluing it in place.



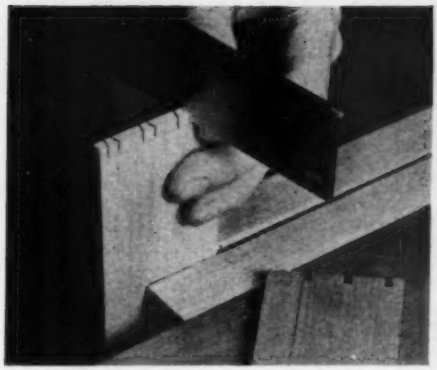
7. Clamp the drawer fronts face to face with several layers of paper between the two pieces of veneer. When the glue has dried, trim the edges of the veneer flush with the fronts.



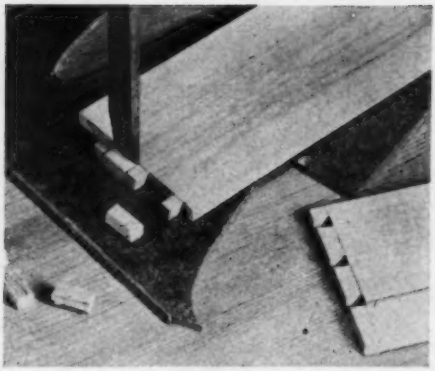
8. Cut dovetails in the sides first—by hand or with the circular-saw table tilted 10 deg. Good layout requires a sharp knife and a gauge with knife-edge pin. See the text for details.



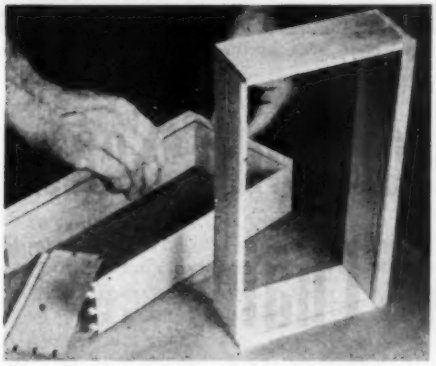
9. Lap dovetails join the sides to the front. Lay out the pins on each end of the front by lining up a side and front and scribing with a sharp knife. Number all the mating joints.



10. Back joints are through dovetails and may be easily cut with a dovetail saw after clamping the work in a vise. Be careful to keep the kerf in the waste and split the scribed lines.

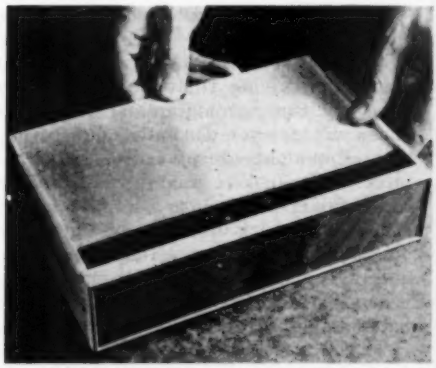


11. Waste is chiseled out between the pins of the back pieces in this way. In the front, cut the pin lines by operating a saw at an angle. Then chisel out, working from the end and back.



12. A trial assembly will show if all joints fit. Then cut a ⅜" groove for the bottom in the sides and front, and rip off the lower edge of the back so the bottom can be inserted.

13. Beaded edges go around the veneered front. Cut rabbets to suit this molding and fit it to the drawer with miter joints. Sand the face of the veneer and then glue the molding in place.



14. Cut drawer bottoms from ⅜" plywood and fasten them in place with a few nails driven into the edge of the back piece after all of the dovetail joints have been glued.

15. Stop blocks glued to the bottom shelf in the position shown complete the construction job. A notched gauge block used as above will enable you to set the drawer faces flush. END

A little padding, a new slip cover, and a salvaged auto seat becomes a comfortable settee.

Converting Automobile Seats into Easy Chairs

By selecting appropriate upholstery, you can make these chairs fit period or modern rooms.

By Fern Fowler

Photos by Bruno Stein

DOES your wife ever clamor to "get into the act"? Well, here's her chance—a job that calls for sewing as well as sawing. Aside from saving yourselves a good deal of money, transforming auto seats into easy chairs will give you decorative and—perhaps more important—exceptionally comfortable pieces. Auto makers build their seats to ease rough riding and to take a lot of wear; the car seats you pick up at the auto graveyard are likely to have more spring life, comfort, and ruggedness left in them than you'll find in many new chairs. You should be able to find suitable ones at any wrecking yard.

The settee shown here grew out of the front seat of a sedan, the chairs from the front seats of a coach. If possible, obtain one-piece seats that are a single rigid unit,

but if these aren't available you can use the type in which the back is hinged to the rear edge of the seat. Simply screw metal plates over the hinges to give rigidity to the two parts. Chairs should be aired, brushed thoroughly, and scrubbed with furniture shampoo cleaner.

The four uprights of each chair are made of two-by-twos cut so that seat height is about 18". At each corner of the bottom of the seat frames there is a 5/16"–18 threaded hole through which the chairs were once bolted to the car floor. A 5/16" by 4" lag screw was driven into the top of each wooden upright, the head cut off, and the projecting shank threaded with a 5/16"–18 die.

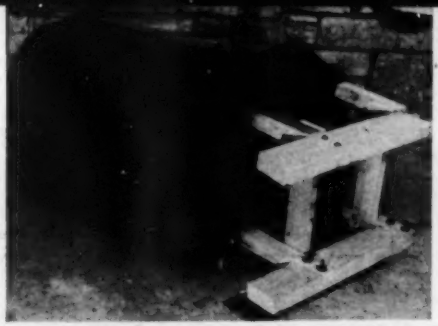
The legs were screwed into position and their lower ends half-lapped and bolted to two-by-four base runners as shown. These must be made long enough (about 20") so that the chair cannot tip backward. Braces are nailed to the legs above the runners. Construction of the settee follows the same plan except that six legs are used and the runners are about 4" longer.

Assuming that this furniture is being built as a husband-and-wife job, the man will have been doing the work described while the little lady sat around sharpening her upholstery needles. At this point the home team takes over. The first chore is to make sure that you don't build in a moth's nest. If the original upholstery is made of wool, you can douse it with germicide or, preferably, remove the covering.

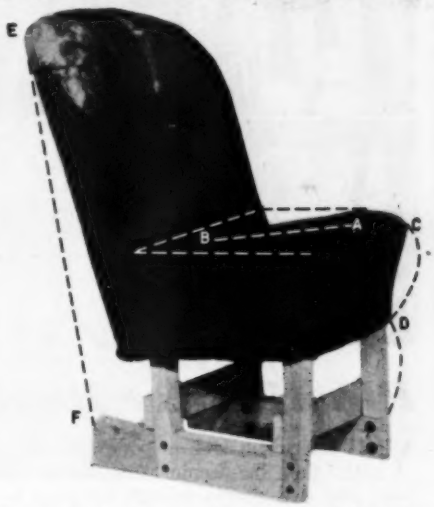
Next, you will want to take out some of the slope (from A to B in the center photo at the right), build up the areas marked C and D, and also the space from E to F. Lay upholsterer's moss on evenly until the proper contours are obtained, add a smooth layer of cotton padding over the whole new form, and cover the chair with heavy muslin —sugar sacks were used here. The cloth was put on as each part of the padding was applied, and the seams were hand sewn with heavy cord and a darning needle.

To improve the contour at the front and set off the flounce, cording was inserted in the slip-cover seam along D. A heavy cord was also nailed to the bottom of the original seat at D, as shown at the right.

The slip cover is made in the usual way. Car seats, even when repadded, are so shaped that no opening need be left for putting on the covers. The back panel is made long enough so that it can be tacked to the base at F to secure the cover.

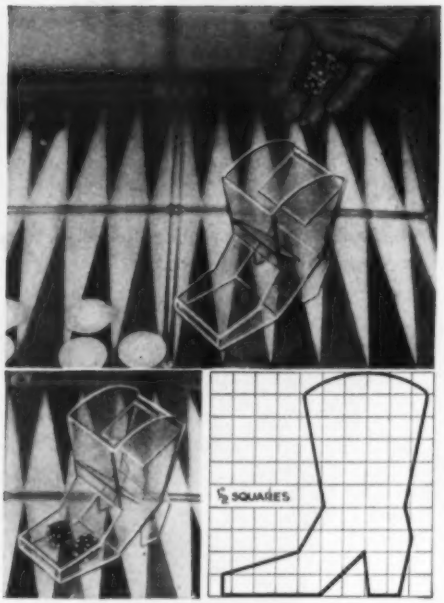


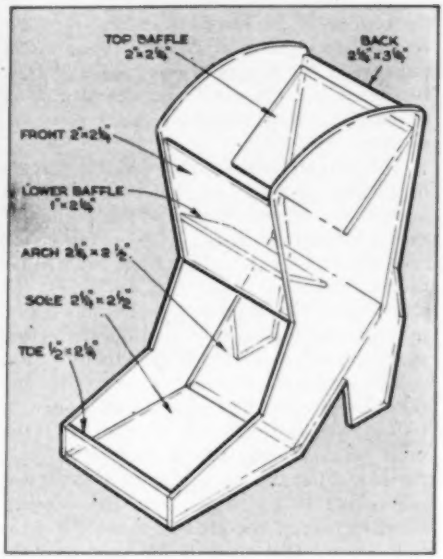
Base runners add both stability and pleasing proportions; these were cut to a length of 19½".



Car seats slope more than regular chairs. The dotted lines show where to add extra padding.

Covered with heavy muslin, the chair is ready for upholstery or slip covers of your choice.





Use these dimensions for dice up to ½" cube; for larger sizes increase them all in proportion.

Plastic Dice Boot Shakes 'Em Up

YOU can add a kick to your dice games with this handsome and serviceable boot, and it is simple enough for your first adventure with plastic. The dimensions given above are large enough to handle dice up to the ½" size. Any plastic of ⅛" thickness is suitable, but transparent stock—either clear or colored—will allow you to watch the eccentric movements of the fateful cubes. For this size, 1 sq. ft. is ample; larger sizes will take proportionately more. Dice are dropped in the top, shaken by the baffles, and come to rest in the open toe.

Enlarge the outline of the side to full size and trace it off onto the plastic. Jigsaw two pieces to this pattern, clamp them together, and file the edges so that they are identical. All the remaining pieces will be cut from strips 2¼" wide. Clamp and file them so that the edges are square and of exactly the same width.

Attach the center pieces to one of the sides with cellulose or plastic cement. Use a small square to make sure that they are all perpendicular. File the necessary bevels on each strip as you fit it into place. The one piece that will need special care is the arch, since the bevel must have the right angle at both ends if it is to fit properly. Before the adhesive has had time to set, put the other side piece in place and make whatever adjustments are necessary to square off the unit. If you prefer, a small piece of felt may be glued to the inside of the arch and sole to give the rattling dice a quieter background.—BUDD SALSIG.

Alcohol-Saturated Asbestos Provides Fast Fire

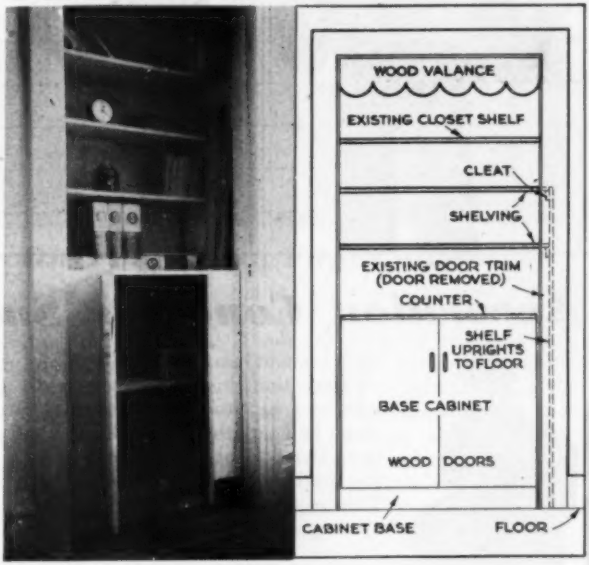
THOUGH firewood may be wet or snow-covered, the outdoorsman who has taken along one or more of these refillable "canned kitchens" may make himself a warm drink or meal in short order. Shielded from the wind with a couple of stones, the can will provide quick, clean heat. Replacing the lid kills the fire.—C. L. MEEHAN.

Shelves and Cabinet Transform Extra Closet

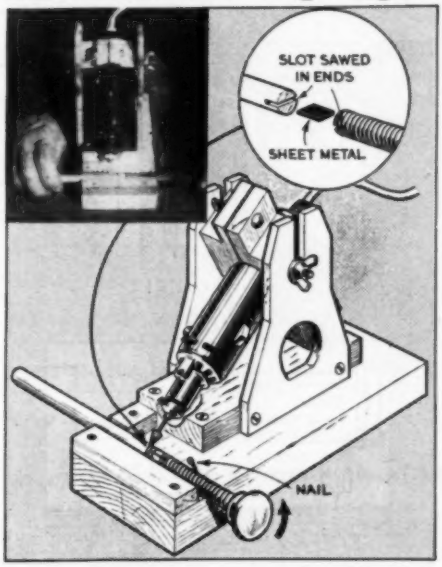
When a bedroom was made over into a den and its shallow closet no longer needed for ordinary purposes, a few shelves and panels served to convert it into a combination bookcase and storage cabinet: The installation was made so as to allow painless reconversion should that be necessary.

First step was the removal of the door and hinges. Cleats were nailed to uprights inserted at both sides to support the 1″ by 12″ pine shelves. The cabinet—which does not have to have a back—is measured to fit inside the door opening. When the cabinet doors are closed, the front of the unit does not extend over the jamb.

A valance is jigsawed from wood and tacked into place by means of small corner strips. Pieces of cardboard are cut out to fill the hinge mortises and are fastened in place with rubber cement. Painting over the cardboard will make it virtually impossible to detect the places where the hinges had been, but the cardboard can be peeled off without difficulty. With care, the same stunt can be used to disguise the strike mortise on the lock side. Remove the strike and cut cardboard to fit in its place.—Paul F. Illes.



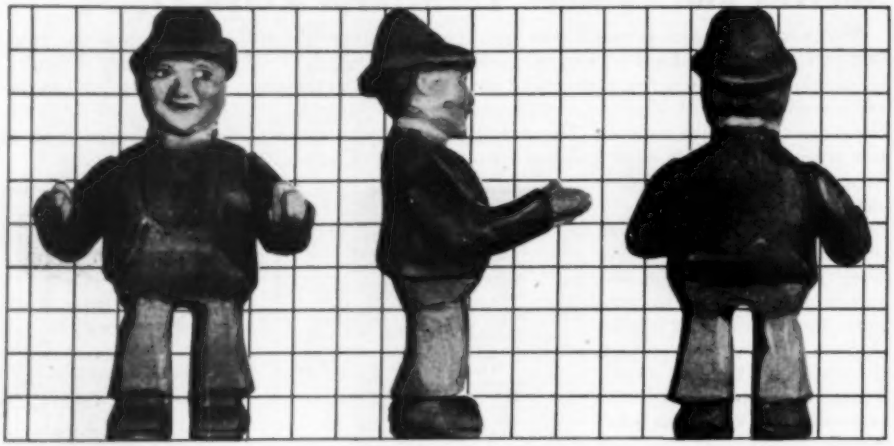
Hand Grinder Jig Duplicates Threads on Dowels



A high-speed hand grinder may be used to transfer a thread to a dowel so that it can replace a badly worn clamp screw, drawer pull, or the like. Guide blocks and a tool holder are fastened to a wooden base and the dowel and threaded piece are both slotted as shown. Join them at the slotted ends by a small square of metal, and start the thread just back of the slotted end. Drive a small nail into the base so that the thread can be turned against it. Place the tool point a little above the center of the work, and slowly revolve the dowel in the direction indicated. After threading, saw off the slotted portion.—Ralph S. Wilkes.

Pad Makes Small Parts Visible

A piece of dark felt glued to a block becomes an oasis on a cluttered bench. Small parts placed on it won't get lost, and tiny objects may be examined easily against the dark background.—Herbert Pfister.



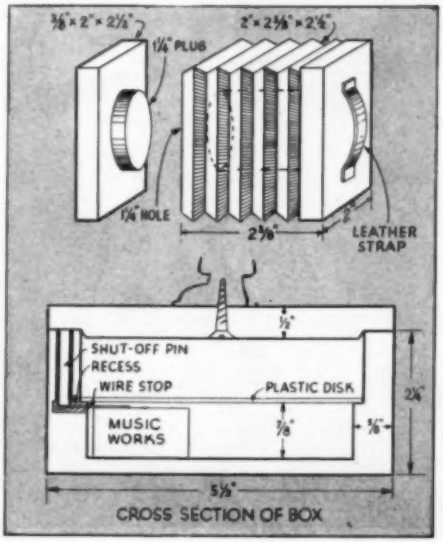
Accordion Conceals Small Jewelry

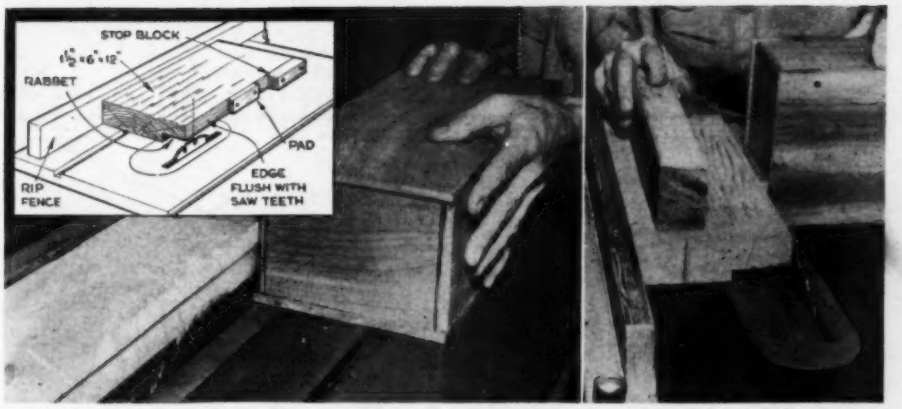
To look at him you'd think that this little man and his stomach-piano had no other job than that of adorning the top of a jewel box. This is just what you are supposed to think, because actually his accordion is a secret safe for rings and other small jewelry. As an extra frill, space is provided in the bottom of the box for a Swiss musical movement that sounds off when you lift the lid.

Saw and carve the little fellow from 2" stock, and make the arms separately out of ¾" wood. Soft pine is a good choice because it carves easily and takes a nice paint finish. Outlines are given above on ½" squares but this can be varied if you make similar adjustment in the size of the accordion and box.

For the accordion, mount a piece of soft wood on the screw center of a lathe and turn out a cavity 1¼" in diameter and 2" deep; then mount another piece and turn a plug to fit snugly into this opening. Cut and carve away excess wood until you have brought the squeeze box down to the size and shape shown. Fasten leather hand straps to the ends with brass escutcheon pins.

The jewel box is turned of hardwood. Glue together three pieces of ¾" stock of 5¾" diameter. Turn out the inside as indicated, and drill a hole through one wall to take a ⅛" dowel shut-off pin. Mount a standard music works in the lower part of the box, allowing the shut-off lever to extend within range of the pin. A circle of clear plastic will cover and protect the musical mechanism yet allow it to be seen. Turn the box lid from ½" stock. The shallow ledge that fits into the box will keep the lid in place. One or two small screws driven from the under side of the lid hold the figure on top.—Elma Waltner.



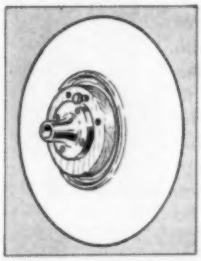


Special Jig Trims Off Projecting Edges on Boxes

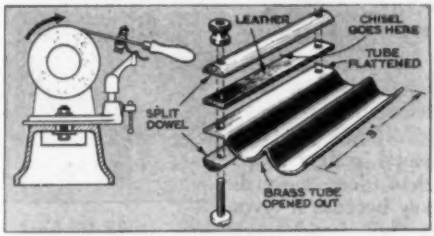
THE usual method of pattern sawing, as in the photo at left above, employs a stationary overhanging fence along which the work is moved to cut off projecting waste. When the end of a box must be trimmed, however, the method is useless, since the vertical projections or sides of the box bear against the fence and thus prevent you from cutting the horizontal ones.

A special sliding jig, shown in the inset drawing and in the photo at the right, solves the problem neatly. It is fitted with a pad of wood of suitable thickness to locate the vertical face of the work just at the line of the saw. A stop block is also nailed on to locate and hold the box in place against the jig. When both box and jig are moved as a unit along the fence, projecting edges are cut off flush as the box is turned on each of its four sides.—JOHN P. ARNOLD.

Screws Free Faceplate Work



AFTER turning a wooden plate or bowl that is glued to a disk on the faceplate with an intervening piece of paper, you may have trouble in splitting off the disk, especially if a bead was turned on the bottom. Attempting to pry it off is apt to damage the bead. To avoid this, drill three holes in the disk before gluing the turning stock on, of a size ½" bolts will thread themselves into. When you are ready to free the work, drop small metal washers in the holes and screw in bolts. Advance each a fraction of a turn until it is pried off.—D. H. MATHESON.

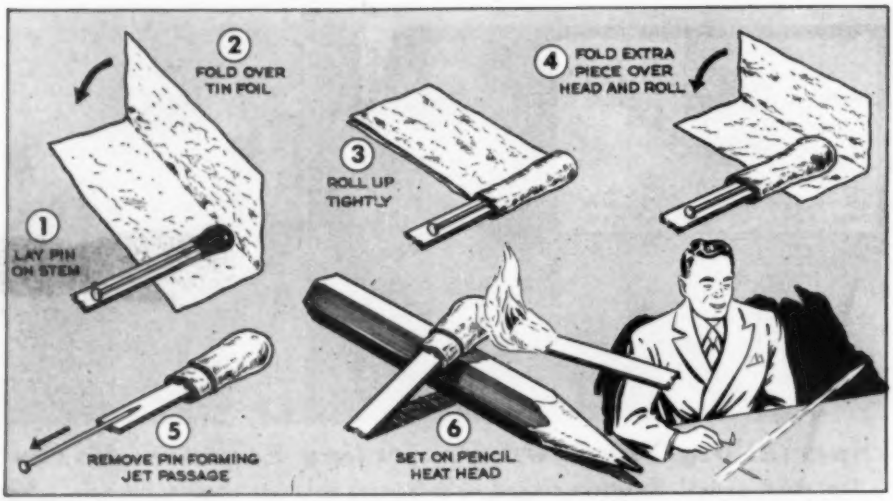


Tubing Guide Aids Sharpening

YOUR scrap box will provide materials for this gadget for sharpening plane irons and chisels. You can remove the tool frequently to dip in water and still return it to the same position against the wheel. A split dowel and an opened-out length of tubing make up the device; it is aligned in use by resting the groove thus formed upon the reversed tool rest of a wood lathe.—PARKER E. HART.

Common Gasket Cement Has Additional Shop Uses

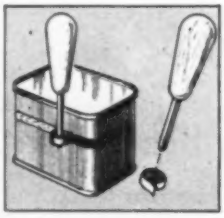
GASKET cement, sold in auto-supply stores in dauber-fitted bottles, is a fine workshop cement. It will hold on wood or metal and is proof against alcohol, gasoline, and water. Use it for holding felt on the base of lamps, for attaching patterns to metal, and securing raveled insulation. It's hard to get off, so keep it off fingers.



Match and Tin Foil Make a Miniature Rocket

IT TAKES less than a minute to build and launch a tiny rocket made from a paper match by the method detailed in the numbered drawings above. When an external flame is brought close to the foil-wrapped match head, heat is conducted inside the chamber. Combustion energy set up here can escape only through the tiny jet passage left by withdrawing the pin. The engine reacts by rocketing off in the opposite direction. Caution: This rocket really travels, so don't try it in a confined space, and make sure that there is no one in the line of fire of the tiny projectile.—ALBERT MEDWIN.

Slotted Pick Opens Cans



A KEY-TYPE can opener of the kind illustrated requires less effort to roll back metal sealing strips than does a small key because it gives a full hand grip. Heat an ice pick or small screwdriver red hot and let it cool slowly to remove temper. Cut off all but about 2" of shaft, file the end round, and then slot it for a length of about ½".—JOHN D. NOBLE.

Old Fishing Reel Saves String

EVER wonder what to do with those short pieces of string? Usually you can't find an untangled length when you want it. One answer is to roll the string onto an old fishing reel fastened inside a cupboard or closet door. When a piece of string is to be added, simply tie it onto the end and then wind it up.—ARTHUR HOLMES.

Baby's Spoon Forms Lapel Pin

WHEN baby graduates from his first diminutive spoon, you can celebrate the occasion by turning it into a lapel pin for his mother. Many baby spoons are sterling silver, beautifully chased or engraved. Soft-solder to the back of the handle a safety catch from a discarded brooch. A safety pin will do in a pinch. For a de luxe job, have the spoon gold plated at a jeweler's.

Scoop Shelves Brighten Corners

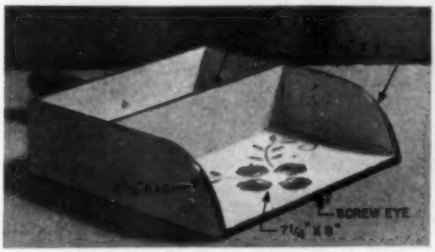
EQUALLY at home as kitchen spice cabinets or living-room shelves for small bric-a-brac, these hanging scoops or dustpans can be turned out with hand tools in less than an evening. You'll find they generally look best in pairs.

Cut a cardboard template for the sides and trace around it on ¾″ plywood. Make two 7¼″ by 8″ back panels, four 2″ by 7¼″ shelves, and four 2¼″ by 8″ sides. Each of these last pieces is rounded at one corner to a 2¼″ radius. Sand all surfaces smooth, and assemble the boards with brads, setting the heads a trifle.

Fill nail holes and any other surface flaws with plastic composition wood. Also rub it into all edges and joints, sanding again when it's dry. Seal the surface with two coats of shellac and then paint with a quick-drying enamel.

File handles with the ferrule sections cut off are attached with countersunk flathead screws. Insert small screw eyes for hanging and drive rubber-headed tacks into the lower corners to keep the shelves from tipping if unevenly loaded. The decorations may either be decals or designs drawn freehand on paper and then transferred with carbon paper. In the latter case, use tube oil colors mixed with turpentine and a little varnish.—BILL LUTHER.

Patterned after old-fashioned dustpans, these hanging sheves are ideal for small bric-a-brac.

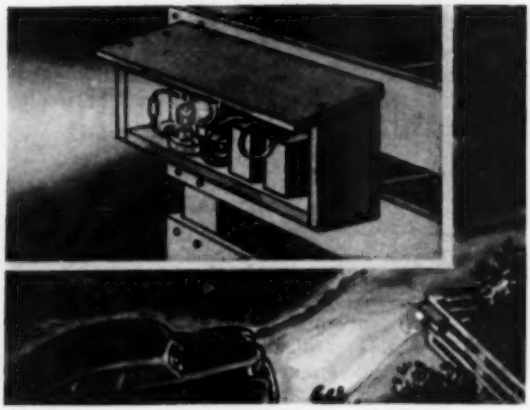


The curved sidepieces overlap both the shelves and the back. Simple butt joints are employed.

Though a bandsaw or jigsaw helps, the sides are easy enough to cut with an ordinary coping saw.

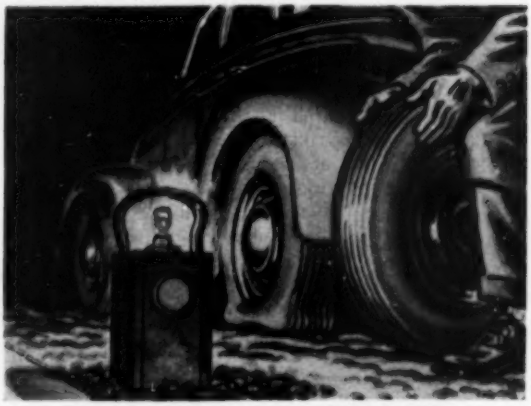
Sand all pieces smooth and draw guide lines for nailing; then assemble with ¾″ wire brads.

Electric organ could be based on glow-lamp oscillator circuits feeding an audio amplifier.



Night hazards can be marked with blinkers that will operate months on the same battery.

Motion is stopped by a synchronized glow-lamp stroboscope. The room lights must be out.



Portable blinkers warn of danger. Similar units guided columns of tanks during wartime action.

Magic with Neon Glow Lamps

By Walter E. Burton

ALADDIN had his lamp, but you can buy a modern substitute at any radio-supply shop. Glow lamps are practically little genii under glass. Once you know their secrets, they stand ready to do all sorts of chores—from playing Aloha electrically to "stopping" a machine in full motion so you can see what makes the wheels go 'round.

A glow lamp consists of two electrodes—wires or plates—surrounded by inert neon gas. When the electrodes are connected to a sufficiently high voltage, light is produced at the negative one. On AC, of course, the electrodes take turns at being the negative one, changing polarity so rapidly that the eye sees both glowing steadily.

Glow lamps consume very little current, the smallest drawing 1/25 watt and the largest about 3. The tiniest have the longest life—about 25,000 hours. Bigger ones are good for 3,000 hours. Even then a glow lamp doesn't burn out; it merely gets dim-

mer gradually. This makes the lamps ideal as indicator or pilot lights, for they can't quit suddenly and so fail to give warning. They produce no appreciable heat and are not sensitive to shock or vibration.

Glow Lamps Trigger Current

The curious thing about glow lamps is that they don't—and then again they do—conduct electricity. Connect a glow lamp to half a dozen dry cells, and nothing happens. Increase the voltage to a certain critical point, and in a millisecond several things happen. The inert gas is ionized, becoming a conductor. Current passes, light is generated, and if you haven't put a resistance in the circuit, the lamp will quickly "run away," or pass so much current as to destroy itself. This instantaneous trigger effect is constant, tireless, and useful in several ways, as will be shown farther on.

To limit current to a safe value, a resistance must be connected in series with each lamp as in Fig. 1. Lamps with screw bases have a built-in resistance and require no external one on ordinary 115-volt house current, but extra resistance should be added if they are connected to higher potentials. When several lamps are connected to one power line, each lamp must have its own resistor as shown in Fig. 2. They cannot be operated in series.

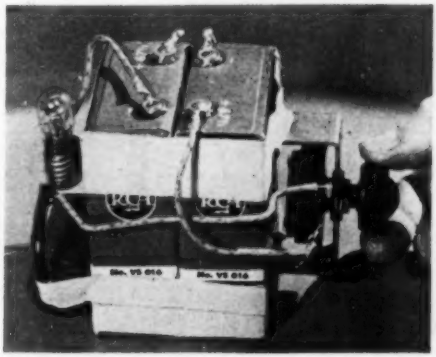
Lamps as Electrical Tools

Everybody, from the radio service man to the householder who just blew a fuse, will find use for a gadget that shows whether the juice is there. Just connect a 1/25-watt lamp with a resistor, some flexible insulated wire, and a pair of phone tips as in Fig. 1. It's a good idea to house the lamp in a glass or plastic tube. The gadget will also indicate DC polarity once the leads are identified. Touch them to a radio B battery of 90 volts or more, mark the lead touching the negative terminal, and mark the lamp base or housing to indicate the lighted electrode.

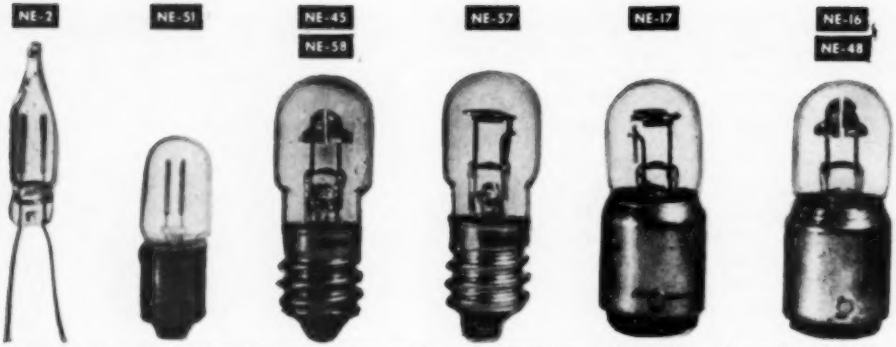
If you add a common radio potentiometer to the tester circuit as in Fig. 4, and calibrate the potentiometer dial, you'll have a handy tool-kit voltmeter. It works on the principle that the ionizing or starting (breakdown) voltage of a lamp is always the same —about 90 volts DC and 65 volts AC for 1/25-watt lamps such as the NE-2 or NE-51 —and that on falling voltage the lamp will suddenly cease glowing at an equally definite point. On DC, this maintaining voltage is about 15 volts less than the starting voltage, but on AC it's about the same.

If you connect the circuit in Fig. 4 to 120 volts DC and turn the potentiometer up, at some point the voltage across the lamp will top 90 and the lamp will suddenly glow. If you now move the potentiometer back slowly, you'll find a point at which the lamp goes out. Mark this point 120 volts DC on the dial. Repeat the calibration on other known voltages of AC and DC. On an unknown voltage, simply turn the knob until the lamp lights, and then back to where it goes out, and read the circuit voltage off your dial. [Turn the page.]

Batteries charge the condenser to ionizing voltage, and it then discharges through the lamp.



High resistance such as 10 megohms gives slow flashing. The unit makes a compact package.



Lamps with wire leads or bayonet bases need external resistors. Screw bases have them inside.

A similar circuit can be used as a sound monitor for use with a microphone and a home recorder or other instrument. With the potentiometer left at the critical point as determined by test, the lamp will flash whenever sound output is too great.

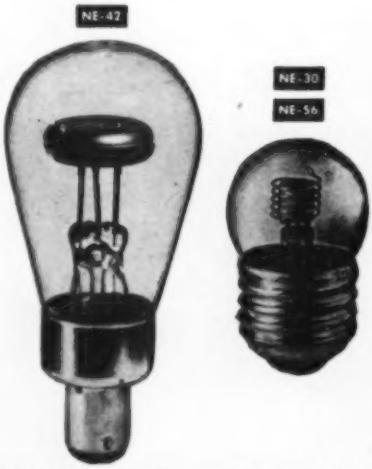
You can also, just for fun, hook the circuit in Fig. 4 to the plate side of the output transformer in a radio. Converting sound to light, it'll show you visually what's coming out of the loudspeaker.

Lamps That Wink at You

If you walk into the Nela Park office of H. M. Ferree, a General Electric engineer, you'll soon become aware of a contraption on one of the filing cabinets, for it winks at you—a reddish neon wink—every five seconds. It consists of a pair of 67½-volt B batteries, a radio condenser, a potentiometer, and a glow lamp. This particular setup has been winking for six months and is expected to keep it up on the same batteries for 18 more. Similar blinkers kept tank columns together in night movements during the war.

The blinker circuit is shown in Fig. 3. For visibility, a ¼-watt glow lamp with circular electrodes, such as the tiny NE-17 or NE-57, is recommended (use an outside resistor with the NE-17). Connect the disk to the negative side; then you can focus the light with a lens or mirror.

Potentiometer resistance in Fig. 3 should be about 10 megohms for one flash per second. Reducing this increases flash frequency, so by turning the potentiometer you can



Twin disks glow in the 3-watt lamp at left. The 1-watt lamp at right fits standard light sockets.

Circuit tester is a 1/25-watt lamp housed in a glass or plastic tube, a resistor, and two leads.

vary the interval. What happens is that the battery charges the condenser quickly or slowly as the resistance permits. The instant the condenser charge reaches the starting voltage of the lamp, the latter "fires," discharging the condenser, which then starts to recharge.

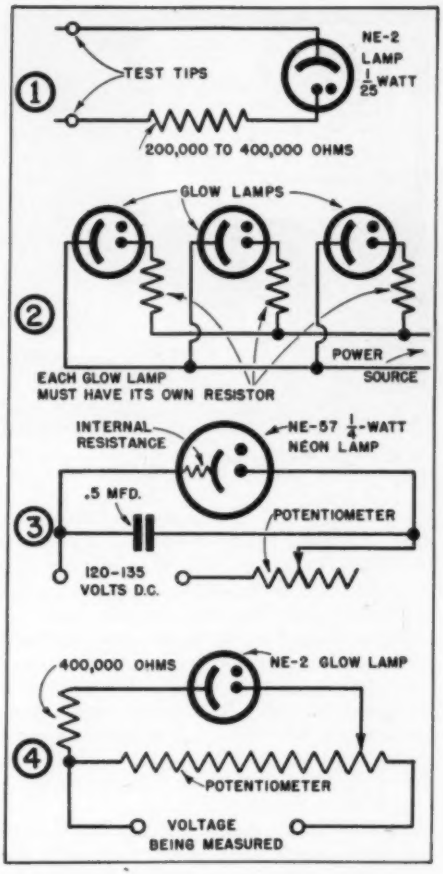
One use for such a blinker setup is as a darkroom timer. Count flashes for timing enlargements or other short-duration processes. Similarly, it might serve as a visible metronome for music students.

Another Nela Park engineer had a roadside mailbox vulnerable to night-time motorists. After rebuilding it once or twice, he installed a neon blinker. The mailbox hasn't been hit since.

Within a limited range such a light might be useful as a dock marker to enable boatmen to find their way back to shore. You could use one to identify your house by night, or by prearrangement as a signal that you are or aren't at home. If you have to leave your car in a hazardous location at night, a blinker may save you smashed fenders or worse. The gadgets might also be used to mark hazardous locations such as cliffs and culverts, and to guide others following in the dark.

Music from a Lamp

Vary condenser capacity and the series resistance, and you "tune" blinker frequency right into the audio range. Such a circuit appears on page 196. A heavy pencil line on the baseboard forms the variable resist-



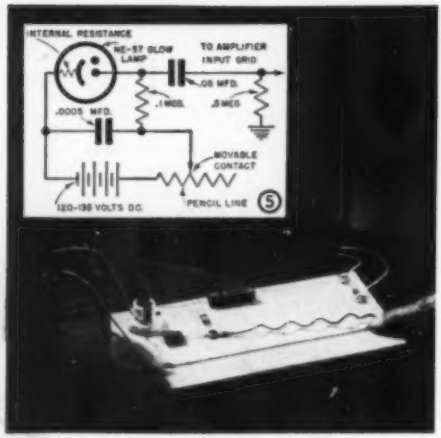
NEON GLOW LAMPS

[ELECTRICITY]

Lamp No.	NE-2*	NE-45**	NE-48***	NE-30	NE-32	NE-34	NE-36	NE-40	NE-42
Watts, Nominal	1/25	1/4	1/4	1	1	2	2	3	3
Base	Wires	Candelabra screw	D.C. bay cand.	Medium screw	D.C. bay cand.	Medium screw	Sk. d.c. bay. cand.	Medium screw	Sk. d.c. bay. cand.
Starting voltage, approx.									
AC	65	65	65	60	60	60	60	60	60
DC	90	90	90	85	85	85	85	85	85
Series resistance, ohms, for									
105 to 125 v.	200.000	30.000†	30.000	4.800†	4.800	3.500†	3.500	2.200†	2.200
250 to 300 v.	750.000	82.000	110.000	13.000	18.000	9.100	11.000	6.200	8.200
300 to 375 v.	1.000.000	120.000	150.000	18.000	24.000	13.000	16.000	8.200	11.000
375 to 450 v.	1.200.000	150.000	180.000	24.000	30.000	16.000	20.000	11.000	13.000
450 to 600 v.	1.600.000	200.000	240.000	33.000	39.000	22.000	27.000	16.000	18.000

*NE-51 same as NE-2 but has single-contact bayonet miniature base.
**NE-57 same as NE-45 except starting voltages are 55 AC, 70 DC, and electrodes are different.
***NE-17 same as NE-48 except starting voltages are 55 AC, 70 DC, and electrodes are different.
Base abbreviations: D.C. bay. cand: Double-contact bayonet candelabra. Sk. d.c. bay. cand: Skirted double-contact bayonet candelabra.
† Internal resistance in base.

POPULAR SCIENCE MONTHLY SHOP DATA



A blinker tuned to the audio range creates music notes, "played" by varying the resistance.

ance, with which a thumbtack makes contact. Slide the flexible lead along the pencil line with the fingers. The tone is something like that of a flute. If the range isn't great enough, experiment with different values of condensers and resistors. You may prefer a series of fixed resistors and switches instead of a sliding contact. Couple the circuit to a standard amplifier through a small condenser as shown. A .5-megohm resistor from input to amplifier ground creates the necessary voltage drop on the grid of the input tube in the amplifier.

A lamp connected across the terminals of an open switch will glow if the rest of the circuit is complete and go out when the switch is closed, serving both to show whether it's open or not, and to locate it in the dark. A glow lamp shunting a fuse won't glow unless the fuse blows; then it signals the dead one instantly.

Twelve tiny glow lamps spaced around a circle make a distinctive illuminated clock dial, yet consume all together about ½ watt. If the clock face is made of transparent plastic, the glow will be diffused enough to silhouette the hands and show them plainly.

Since glow lamps have no thermal lag, but wink out the instant current is cut off, they have useful stroboscopic characteristics. For instance, you can check the speed of a camera shutter by photographing a lamp burning on 60-cycle AC. Use fast panchromatic film, and *move* the camera or the lamp during exposure. Thus a series of images is obtained. Since there are 120 flashes per second, you have only to count the images to learn how long the shutter was open. For instance, 12 flashes show the shutter speed was 1/10 second.

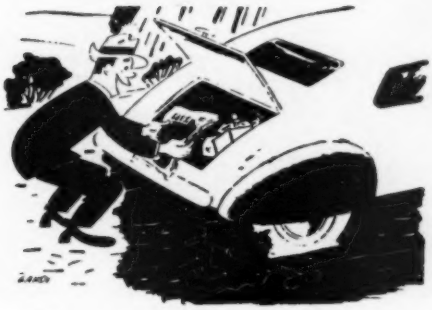
Stroboscopic disks commonly used for checking the speed of motion-picture projectors and phonograph turntables are used with neon glow lamps. Naturally no other light must shine on the moving disk. When the machine runs at the correct speed, the disk appears to stand still, while any deviation makes it seem to run backward or forward at a rate proportional to the difference.

Machinery, springs, anything in repetitive motion, can be studied stroboscopically by neon lamps. Use a blinker circuit with a frequency comparable to that of the action. Turn out all other light, and synchronize the lamp with the device by using a potentiometer control. You can stop action completely or, by going just a little "out of phase," get the effect of a slow-motion camera. END

Pocket Tester from Old Fuse

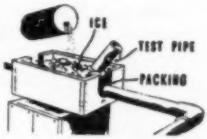
A HANDY tester can be made from a burned-out multiple fuse of the kind that glows as each fuse link is blown. Pry off the cap, being careful not to damage the fine leads going to the lamp and the tiny resistor. Bore a hole in a short plastic rod to hold the lamp. Solder on two insulated test leads, tape all joints, and pack the bulb and wires in securely with plastic composition wood. The gadget will tell if a circuit is alive, identify the "hot" side, and track down shorts, opens, and grounds.

What's Your Ingenuity Quotient?



I Was in a Hole when a tire blew out on a back road. Having a spare tube but no blowout patch, I laid an old magazine inside the casing. It took me 20 miles to a gas station with pages to spare.—C. DAWES.

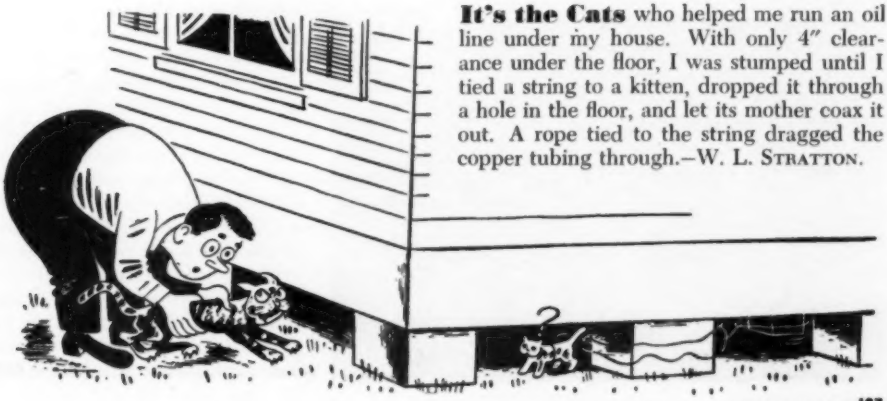
Leaky Faucets, no cellar shut-off, and the yard valve buried by a shift in the fill! Rather than dig it out, we built a box around the cellar main line, stuck a capped nipple full of water next to the pipe, and poured in ice and rock salt. When water in the nipple was frozen, so was a plug in the line. We fixed the faucets, thawed the line with hot water, and nary a drip.—ELTON STERRETT.



Gutters Are Silent, so when I phoned my sister to ask what size leader to buy, they wouldn't talk. The ladder was too heavy for her to manage and she couldn't reach high enough to measure the spout. Finally I asked her to lay a bar of soap on a mop and press it against the spout. After measuring the impression on the soap, she gave me the size.—ARTHUR TRAUFFER.

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

It's the Cats who helped me run an oil line under my house. With only 4" clearance under the floor, I was stumped until I tied a string to a kitten, dropped it through a hole in the floor, and let its mother coax it out. A rope tied to the string dragged the copper tubing through.—W. L. STRATTON.



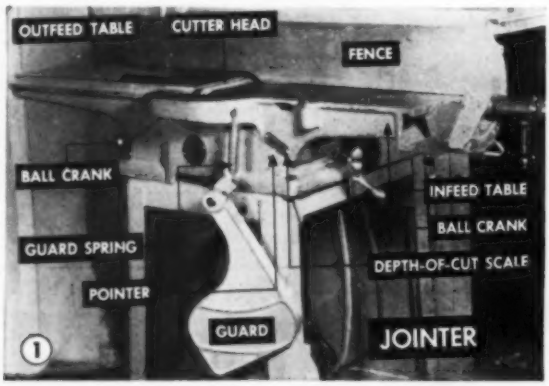
Surfacing with Power Tools

Second in a series on basic jobs in the woodworking shop, this article describes techniques.

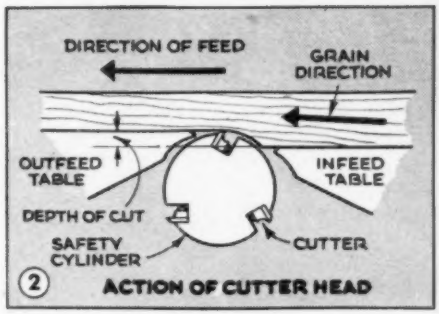
By Edwin M. Love

SURFACING a board, frequently a tedious task by hand, can usually be done faster and better by any of several different power tools. While a jointer is primarily designed for working the edges of boards and for truing up square stock, as for table legs, it will surface narrow lumber quickly and can even be used to plane stock wider than the machine. The usual small 4" or 6" shop jointer has three keen blades set into a slotted cylinder belted to turn about 4000 r.p.m. An "infeed" table that can be adjusted for depth of cut supports the board as it is fed against the cutter head; an "outfeed" table, set level with the blades at the top of their travel, carries the surfaced end of the board. These parts can be seen in the photo above and in Figs. 1 and 2.

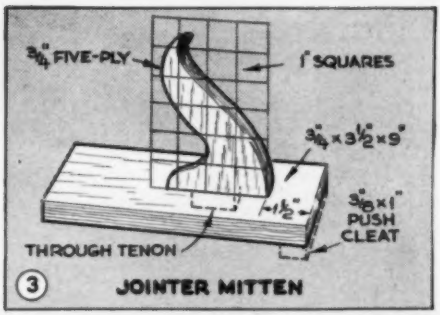
Since such jointers can trim 5/16" or more from the thickness of a board, it is easy to smooth rough stock with one cut. Loosen the lock screw on the infeed table, lower the table by turning the ball crank beneath it, and check the depth of cut on the scale.



Lumber can be safely fed by hand if it is 1½" thick or more. Set the fence far enough to the right to allow the full width of the board to pass over the cutter head. Push the wood forward with the right hand while the fingers of the left hold it firmly down on the infeed table. Many workmen consider it poor practice to allow the forward, or left,



2 ACTION OF CUTTER HEAD



3 JOINTER MITTEN

hand to follow the board over the blades. Instead, let the hand slide back until the front portion of the board bears on the outfeed table. Then carry the left hand around the side of the jointer and place it on the end. While modern "safety" cutting heads are somewhat less dangerous than the older square type, it is only common sense to keep the guard in place whenever possible.

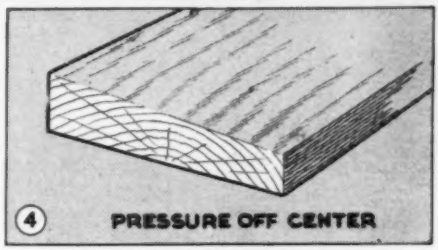
A pair of "mittens," or push blocks, is good safety insurance, and indispensable for thin stock. To make them, mortise comfortable handles into bases big enough to shield the hands, as shown in Fig. 3. The push cleat is attached only to the follower mitten.

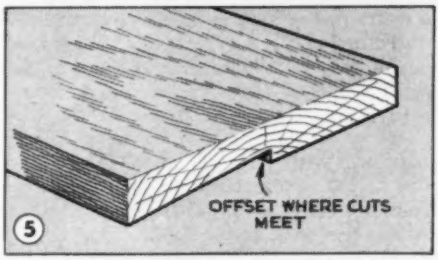
Twisted wood must be jointed with pressure on the high corners to keep the piece from rolling with the twist. It is advisable to make a short pass or two to reduce the high corners, or to take a cut from the convex center of a board so the entire board can be passed over the cutters without rolling out of level.

Since the cutter action tends to lift the work, pressure applied at one edge causes that side to cut faster than the other, giving the board a wedge section (Fig. 4). A wide board can be smoothed fairly well by passing half the width over the machine, turning it end for end, and planing the other half. Distribute the pressure evenly, or a deep offset, as shown in Fig. 5, will remain where the two cuts overlap. A fine cut reduces such a difference, but it is seldom possible to prevent it entirely.

The cutter blades stay sharp longer if you plane only clean stock without dirt, imbedded nails, or screws. Clean out the shaving chute occasionally, for if it clogs, the cutter head will throw shavings out on the table. Shavings driven into the surface will cause bruising and pockmarking even on hardwood (Fig. 6).

Excellent surfacing jobs can be done with


4 PRESSURE OFF CENTER



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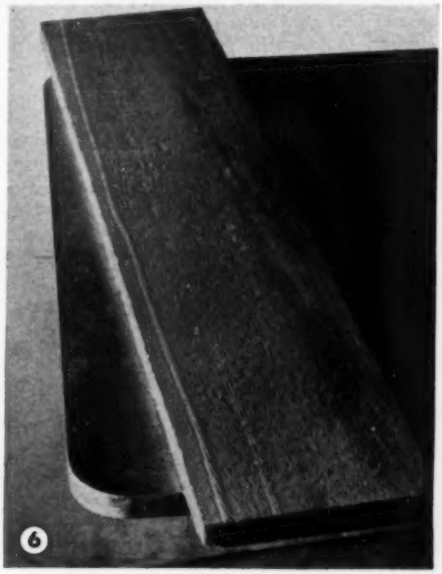
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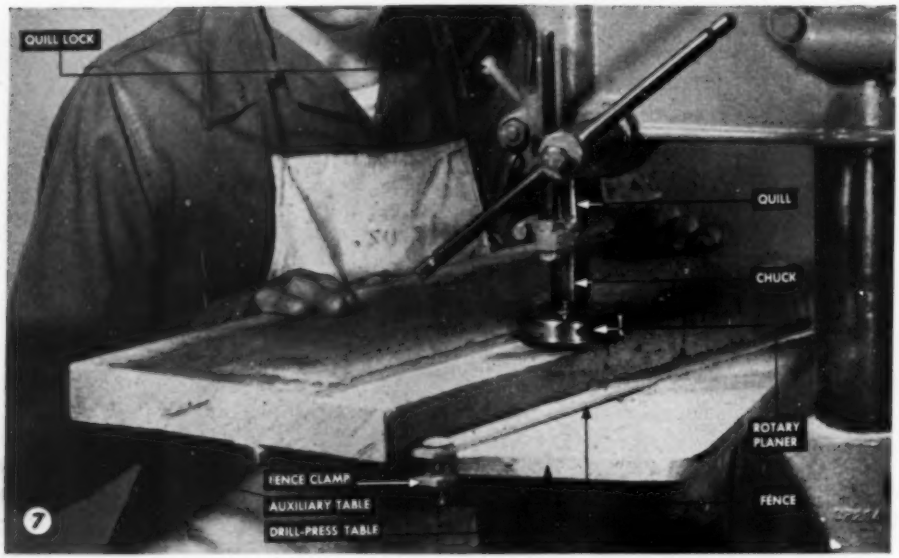
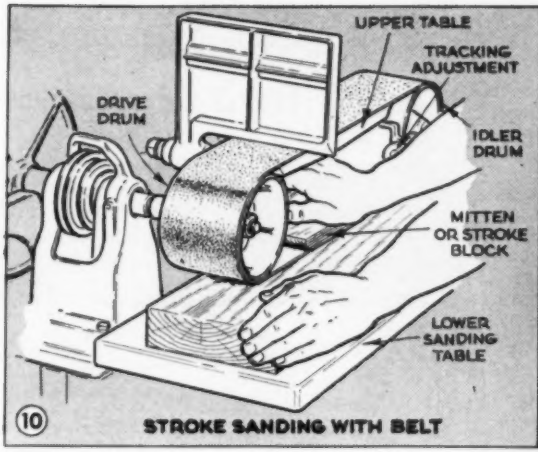


a rotary planer used in a drill press, as illustrated in Fig. 7. A typical tool of this kind has three small blades, ground sharp on the outer and lower edges, clamped in an aluminum body. Insert the planer in the drill chuck or attach it to a Morse taper spindle adapter. With the quill at the top, adjust the height of the table so that the board resting on it is about ¼" below the blades. Across the back of the table clamp a strip of wood for a fence, placing it so that the planer will overhang the edge of the work slightly. Lower the planer to a point where the cutters will bite deeply enough to remove the entire surface.

Pass the board evenly from left to right under the planer while forcing it against the fence. Lifting an end or edge causes gouging. For the second pass move the fence back and repeat the operation. When the center of the board is reached, turn it end for end and repeat. After a little practice the fence can be dispensed with.

Burning may result if the blades are dull or the feed is too slow. Striations or circular scratches bulging toward either side show that that edge of the table is slightly higher than the other. To remedy this, remove the table pin, loosen the lock nut a trifle, and strike the high edge with the hand. Tighten the nut and try a new cut or test the table for levelness by using a wire with a double bend, as shown in Fig. 8. As the chuck is turned, the tip of the wire rubs the high spots. The table of an old drill press may be worn down at the edges, causing uneven cuts. One cure is to clamp on a flat board as an auxiliary table, shimming it up with paper or cardboard at the low parts.

Sanding on a drill press is an operation



10 STROKE SANDING WITH BELT

11

similar to planing. Rest a planed board on the table and lower the sander to touch it. The pressure should be light enough to permit the piece to be drawn from under the sander while it is stationary. Set the speed fairly high and pass the board smoothly beneath the sander (Fig. 9). Rough boards can also be sanded, but the paper grit is conserved by planing the board first. Burning may be caused by too high a speed, clogged paper, slow feed, or a combination of these faults.

A fast and thorough job of sanding can be done with a belt sander. Such a machine has a sandpaper belt passing over two pulleys that are adjustable for tension and alignment. Small machines have a flat backing plate below the upper side of the belt, while some have a table below the belt in addition. To use the upper table, rest the board lightly on the moving belt and stroke it evenly from end to end. Avoid rocking it over the ends, since this hollows the board. If the lumber is wider than the belt, move it sidewise progressively to give even sanding over the entire face. Use the fence, or dam, whenever work permits.

Sanding beneath is accomplished by resting the board on the adjustable lower table and stroking it with a mitten pressed on the back of the belt (Fig. 10). Lower the mitten gradually and lift it easily at the end of the board or stroke. Move the board for another stroke. If a finishing cut with a fine-grit belt is taken, little hand work is needed to prepare for a high-grade paint or varnish job.

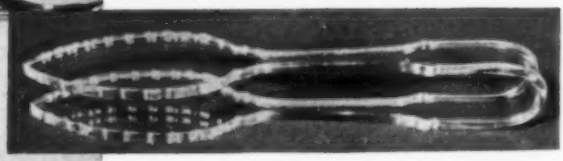
Pieces of wood short enough to hold against a disk sander with little or no projection beyond the edge are readily surfaced by grasping the piece (Fig. 11) and moving it around over the disk. Remember that the edge of the disk travels faster than the center and in consequence cuts faster. Be sure to hold the work firmly, especially if you don't keep it down on the table. The reason for this is that if it should grab while bearing against the rising half of the disk, it may be pulled from your grasp. In general keep work on the table, in contact with just the downward-moving part of the disk.

A typical portable belt sander, illustrated in Fig. 12, is used much like a hand plane. It is raised at the end of the stroke, but unlike the plane, it must not be allowed to pause at any point in its progress from one end of the board to the other, since the belt cuts continually whether the body moves or not.

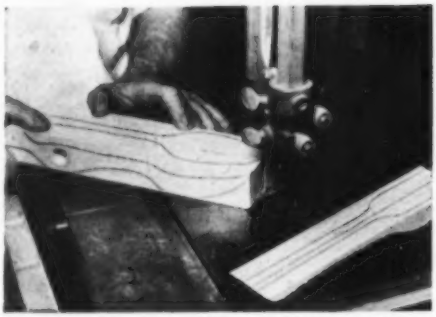
TO BE CONTINUED

12

Serve Salad with One Hand



By John P. Arnold



Band sawing reduces fork and spoon to shapes that can be readily completed with hand tools.

Fit the scissor joint at an early stage. Keep both pieces in square form as long as possible.

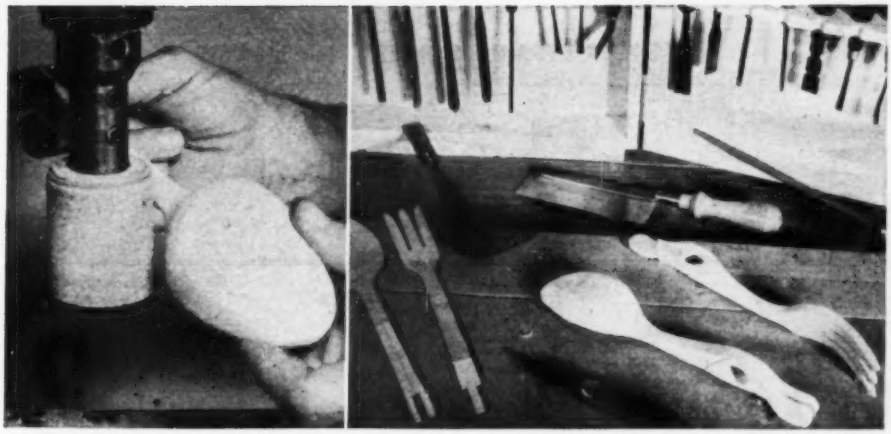
INSTEAD of struggling with slippery wisps of lettuce when serving guests, you can be nonchalant when dishing out the green stuff with this scissorslike gadget. It won't let you down. The plastic tongs, a good companion piece, are just right for asparagus.

For the salad server, you'll need two blocks of rock maple, Osage orange, or other straight-grained hardwood that has exceptional strength in thin cross section. Shaping can be done entirely with a knife or two, a rasp, and sandpaper, but a bandsaw and sanding drum will speed the work considerably.

Trace top and side outlines on paper and transfer them with carbon paper to the stock—or, if you plan to make several servers, cut templates of the outlines out of thin plywood, cardboard, or fiber. Roughly bandsaw the plan or top outline of each piece. Then brad the waste back in place and saw the side profiles. In sawing, leave plenty of material around the joint. When finished this should fit tightly.

Keep the pieces in the square as long as possible, working over the surfaces generally, hollowing the inside of the spoon, enlarging the finger grips, and fitting the joint. Then bring all parts down to the finished dimensions, using extreme care while shaping the tines of the fork.

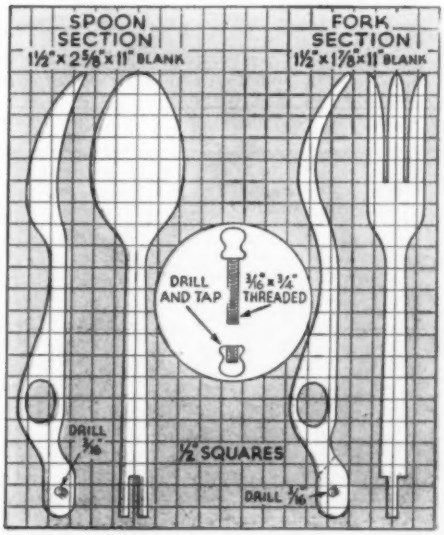
Join the spoon and fork with an ornamental pin, threading the shaft and tapping the knob so that the two members may be taken apart for cleaning. The pivot pin

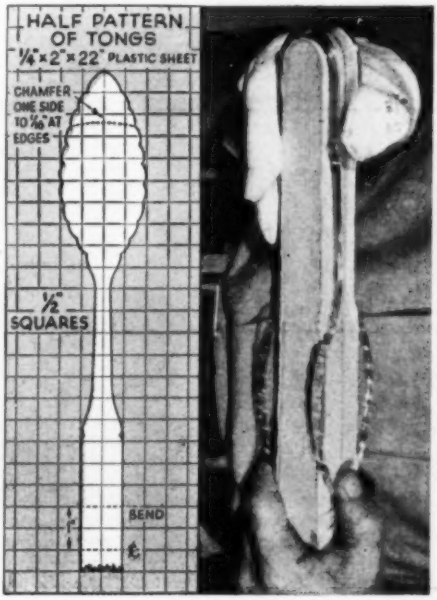


A sanding drum on the drillpress helps smooth the contours of the roughly finished fork and spoon. The final shaping is done with chisels, gouges, and sandpaper. Above right are the tools, profile templates, and the shaped parts ready for final carving and finishing.

might be made from metal, plastic, or ivory —or perhaps you can find something suitable in the scrap box. Finish the wooden parts by rubbing olive oil in freely.

The clear-plastic tongs do not have any ornamentation other than a pleasing outline and scalloped edges. After jigsawing the blank from ¼″ clear plastic, polish it, heat in an oven, and shape it over a flannel-covered wood block, holding it until almost cool. The wood form should taper in thickness from 1″ at the end around which the plastic is bent to 2″ at the other. This will give the tongs a V-shape and therefore the requisite spring to open when released. If you do not get the desired shape the first time, the plastic may be reheated and re-formed. The tips should be thinned down as specified in the drawing for appearance and for greater convenience in use.





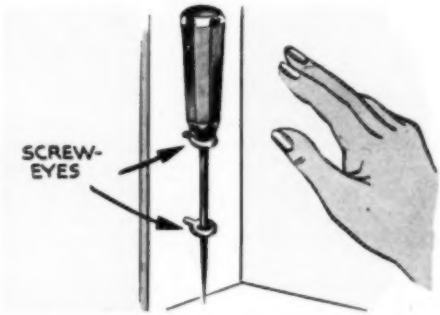
Top and side profiles of the server parts appear above. Bend the heat-softened plastic tongs over a tapered wood form as at the right.

KEEPING THE HOME SHIPSHAPE

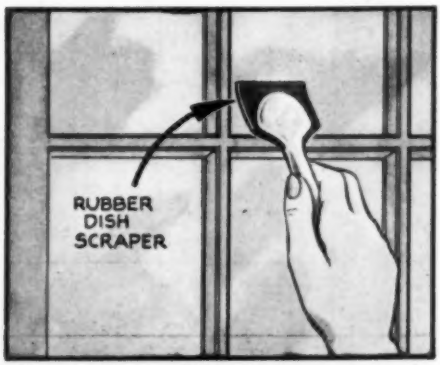
Sheer stockings can be dried out of doors even on windy days. A few marbles dropped into the toe of each keep them from whipping about.

To keep feathers from working through pillow ticking, run a waxed iron over the inside of new ticking before filling it with feathers.

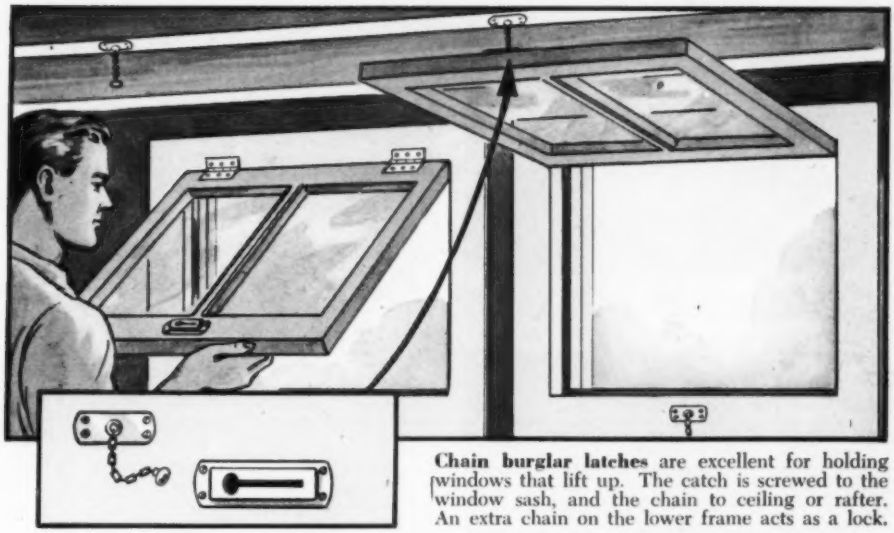
A pie plate pivoted on a nail or wood screw makes a handy revolving tray for spices. Mount it on a kitchen shelf with a washer between, letting it overhang to make it easier to spin.



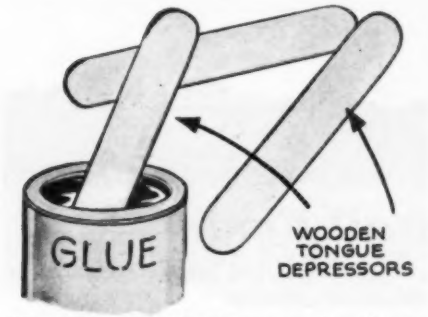
An ice pick can be dangerous if left lying in a drawer with other utensils. Two screw eyes placed about 3" apart at the back of a shelf or inside a cupboard make a much safer holder.



When washing small windowpanes, use a rubber dish scraper as a squeegee. It fits between frames that are too narrow for a regular wiper, yet does a thorough job in all the corners.

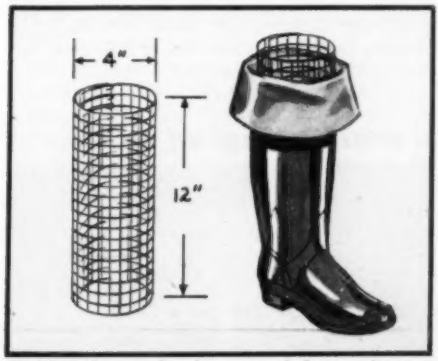


Chain burglar latches are excellent for holding windows that lift up. The catch is screwed to the window sash, and the chain to ceiling or rafter. An extra chain on the lower frame acts as a lock.



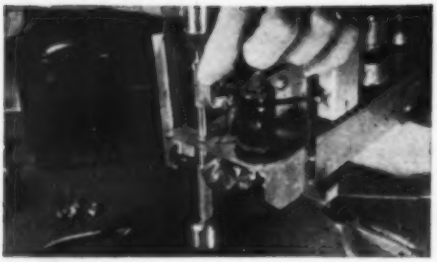
Wooden tongue depressors are fine glue applicators and paint stirrers. Available at most drugstores, they're so cheap you can throw 'em away after use. If too wide, they split easily.

Small touch-up paint jobs are often postponed because of the labor of cleaning brushes afterwards. Paste a memo on the paint can you will use so you'll remember to do all jobs at once.

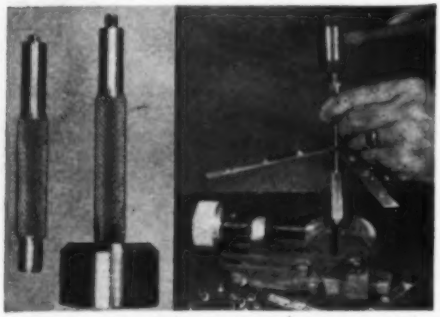


Rubber boots dry better and faster if air is allowed to circulate in them. This is aided by a cylinder of hardware cloth inserted in each. Turn inward any sharp wire ends or edges first.

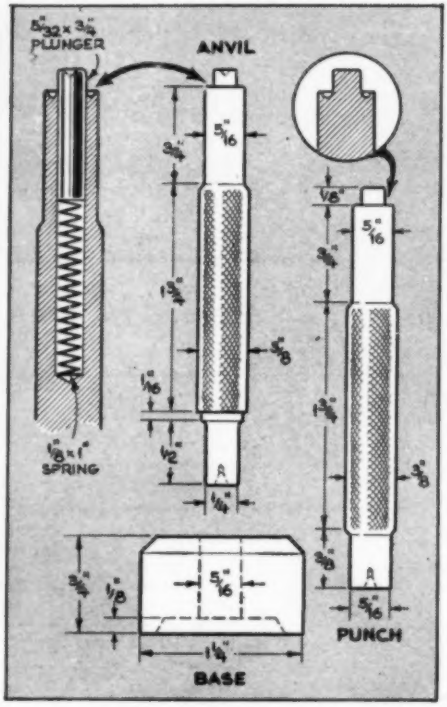
Collapsible tubes holding cement, glue, and wood putty can be securely resealed after opening with small cup hooks as above. The hooks also serve for hanging the tubes on a wall.



Use the base for installing grommets in radio chassis or on work where a vise isn't convenient.



Turn the tips and annular grooves to suit the grommets you buy. The plunger slides in as the punch turns over the edge of the grommet.



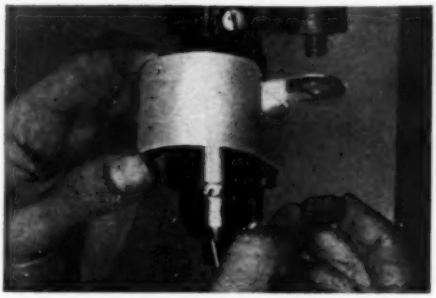
Drill-Rod Tools Install Eyelets

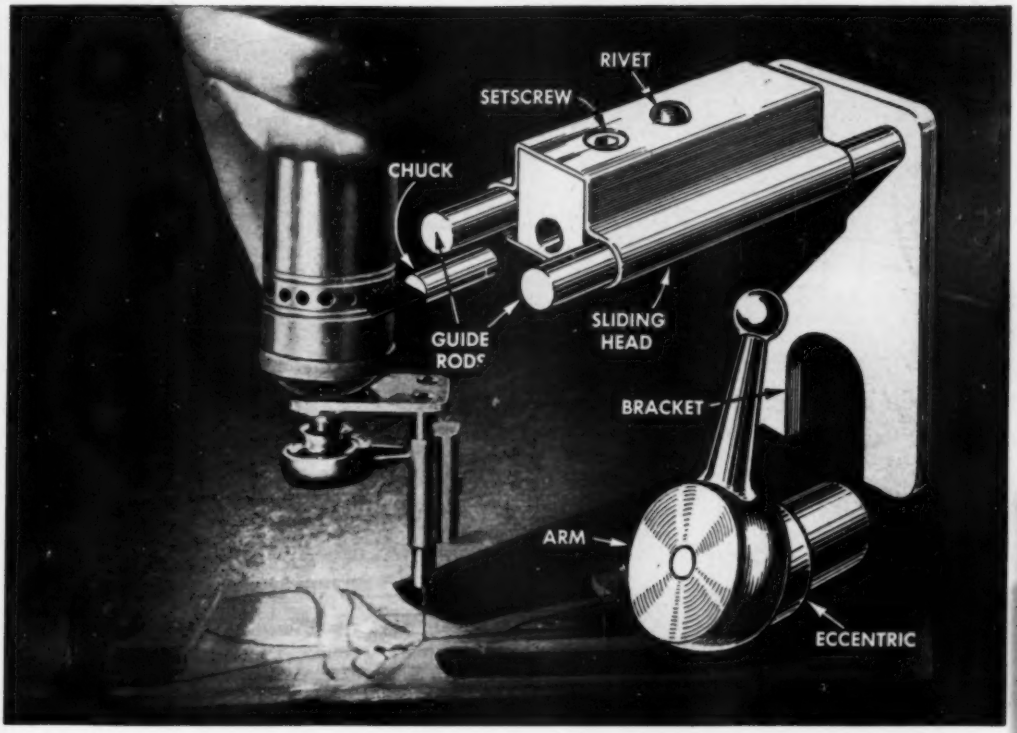
EYELETS or small grommets are very handy in the shop for joining materials together permanently. They are less bulky than nuts and bolts; they join materials too thin or too soft to be tapped; and unlike rivets they leave a smooth-edged hole suitable either for the passage of wires or for hanging the object up on a finishing nail.

Turn the tools from drill rod to the dimensions shown in the drawing, or else obtain a supply of eyelets and proportion your tools to suit. Hardening and tempering to a blue color is desirable, though if the tools are to be used infrequently they can be left soft. File flats on the shank of the anvil so it can be held in a vise. You can retain the plunger either by turning a wide, shallow groove or filing a flat in it, and driving a pin into the body to project inside but clear the recessed portion.—JOSEPH F. GRECE.

Guard Prevents Drill Press from Slinging Oil

ON MANY drill presses oil from the bearings runs down inside the quill, collects on the spindle or upper face of the chuck, and is thrown off by centrifugal force when the press is operated at high speed. Aside from annoying the operator, it sometimes stains wood being worked. The simple guard shown in the photo, made of fairly heavy-gauge aluminum or brass, will stop this annoyance. A convenient way of mounting it is under the nut at the bottom of the depth stop.—HENRY HANSCOM.

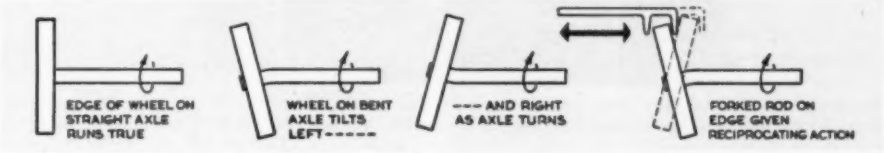


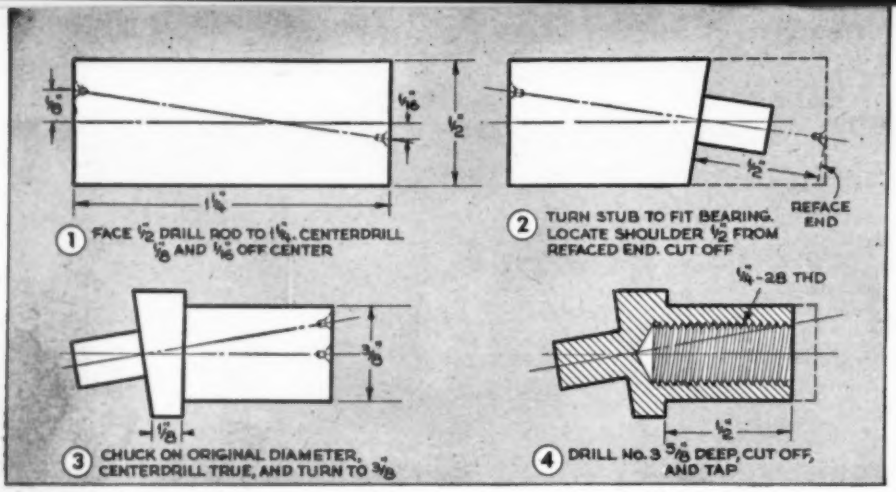


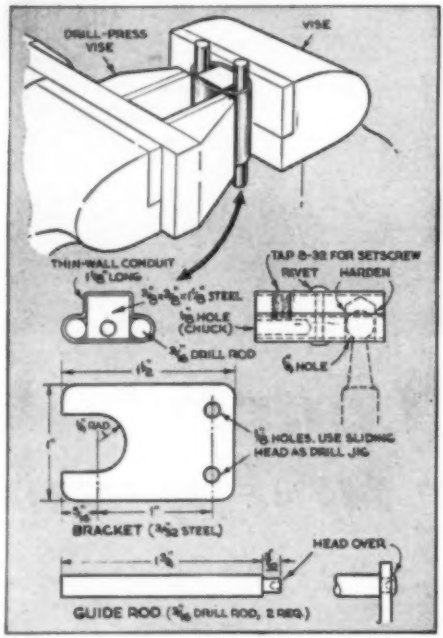
"Wobbler" Converts Grinder to Jigsaw

HIGH-SPEED hand grinders or hand motor tools, having won a place in most well-equipped shops, can be given still greater usefulness with this attachment, which converts rotary to reciprocating motion. It will take a jigsaw blade, needle file, abrasive stone, or engraving point. As a saw it will deliver about 10,000 cuts per minute, and since it has no frame, it works well as a keyhole saw. As a file or grinder it performs nicely in close quarters, dressing small fillets or forming notches or slots. The engraving point marks almost anything—glass, hardened steel, even turning bits. With a tiny rasp or chisel in the chuck the tool is fine for woodcarving; with a felt-pad attachment it polishes metal or plastic jewelry.

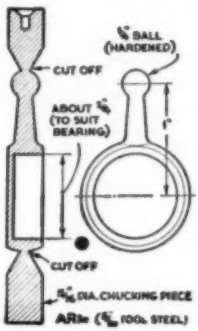
The operating principle, shown diagrammatically below, is that of a wabble or swash plate, a fairly uncommon mechanical movement sometimes used in high-pressure pumps. Just as a bent axle or cocked wheel







will wobble in turning, the wobble plate will produce reciprocating motion in forks or followers that ride on it. In this attachment a short arbor threaded on the motor shaft has a stub end that deviates by about 11 deg. from the arbor axis. On this stub fits a small ball bearing. An arm around its outer race has a hardened ball at the end, and this goes in a hole in a cross-head sliding between two guides. The arm transmits a rapid in-and-out motion to the block, the stroke being about 3/16″ long. A hole in this block with a setscrew entering it holds the saw, file, or other tool.



Make the eccentric arbor first, following the steps suggested at the top of this page. After being faced and centerdrilled, the work is mounted between centers with the 1/16″-off end at the tailstock and turned a

Turning the ball on the arm, left, after it's been bored out to take the ball bearing, as in the center. Note the bearing on the tool rest. The complete unit before assembly is at right.

light press fit for the ball bearing. I used a shielded New Departure bearing No. 7035. The shoulder should be ½″ from the end after the latter has been refaced just enough to permit measurement. Reversed in the lathe (and recentered true if you wish to use tailstock support), the work is held in a 3-jaw chuck or ½″ collet, turned to ¾″, drilled, cut off, and tapped to suit the threads on the motor-tool shaft.

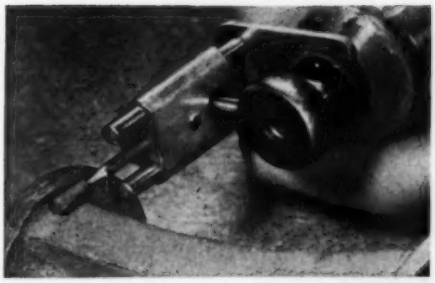
If you modify the dimensions of this part, keep the amount of wobble fairly small or the tool will vibrate excessively. Also, keep the bearing-locating shoulder at or near the intersection of the two axes on this arbor, or the ball at the end of the arm will slide in its hole like a piston.

Lay out the arm on a piece of 5/16″ high-carbon steel plate, mount in the 4-jaw chuck, and bore out a light press fit for the outside of the bearing. Centerdrill the ends, cut away some of the excess metal with a hacksaw, and turn to shape. The ball, which may be roughed out with a cutting tool and then finished off in the lathe with a file and emery cloth, should be held as closely as possible to a uniform ¼″ diameter. After cutting off the stub ends and cleaning up the piece with emery, harden the ball and temper to a light straw color.

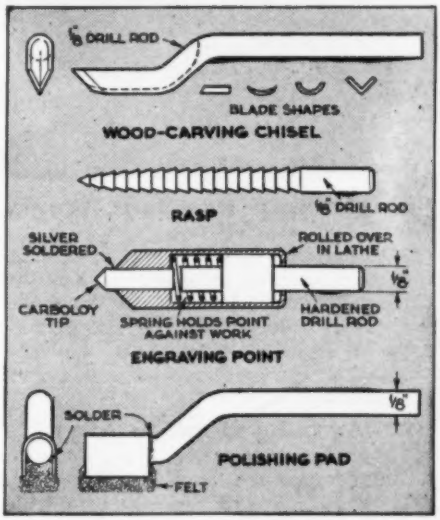
The crosshead consists of a length of thin-wall conduit squeezed around a little billet of square steel. Shape it with two vises as shown, setting the jaws of the drill-press vise ½″ apart. Drill the setscrew, rivet, chuck, and ball holes, press out the block for hardening and tempering, and then reassemble and rivet together. (Don't forget to tap for the setscrew before hardening.)

Saw out the mounting bracket, adapting it as necessary to suit your hand grinder. Drill a hole for one of the guide rods, which are lengths of 3/16″ drill rod shouldered at one end, and then use the crosshead itself as a drill jig to spot the hole for the other guide rod. Assemble the bearing on its eccentric arbor, retaining it if the fit is too easy with a few light punch marks around the edge of the stub. Press the arm over the bearing, holding it in place if necessary in the same way.

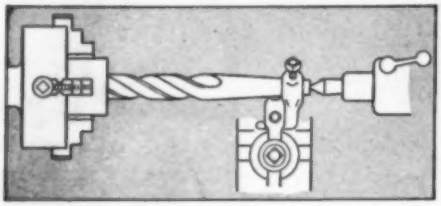
Some of the many tools suited for use in this attachment are suggested at the right. Ordinary jigsaw blades, knives, and other flat-shanked tools may be chucked with a slotted piece of ⅛″ rod. Saw blades work best if they are mounted to cut on the "pull" stroke.—ALFRED J. BROSSEAU.



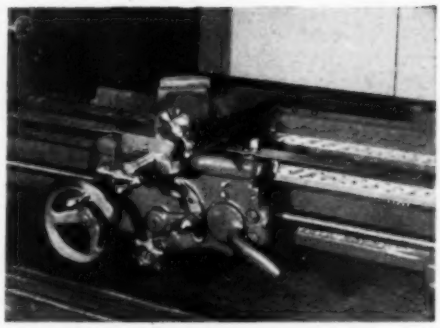
Countless uses in the shop will be found for the reciprocating attachment. Above a round stone is employed to dress a fillet on a casting. At right, an engraving point writes on hardened steel, and below a needle file touches up a metal plate. The drawing suggests different kinds of special tools that can be made up for use in the attachment.



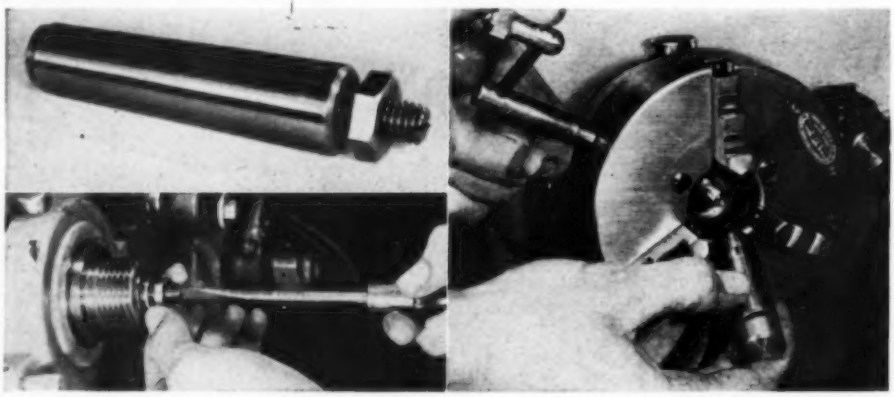
NEW SHOP IDEAS



Using Big Drills. A straight or taper-shank drill that is too large for the tailstock chuck or tailstock itself may be used with the method shown above. A lathe dog resting on the cross slide will take the drilling torque. Spot-drill the work to insure an accurate start, use a slow speed, and feed with the tailstock ram. If you are making a through hole, apply back pressure against the dog with the tool holder and carriage when the drill is about to break through at the far end.

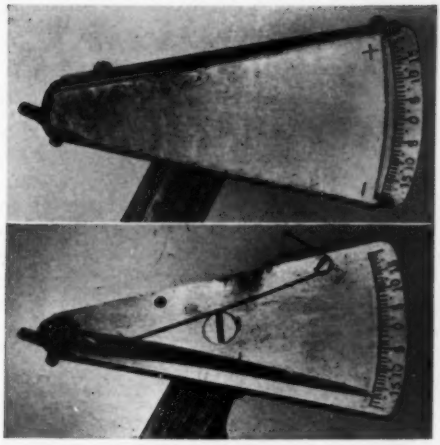


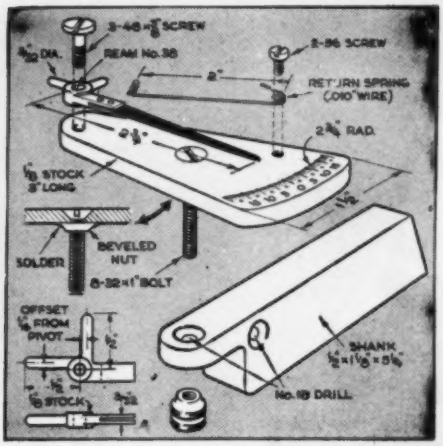
Guard Your Ways. Dropping a chuck or other heavy object on the carriage ways of a lathe will be much less harmful if they are protected by these sheet-metal shields. Four of them are bolted to the sides of the carriage with 8-32 machine screws. They are made of 1/16″ by 2″ by 9″ sheet metal, formed to the inner contours of the carriage ways. The rear left guard is slightly shorter than the others so as to clear the gear-guard bracket, and a clearance hole is drilled for the carriage lock.—B. J. Corey.



Spindle Stop Positions Work. Round stock smaller than the hole in the chuck often slips back under heavy drilling, turning, or knurling, no matter how hard the chuck is tightened. An adjustable stop inside the spindle prevents this and also permits accurate repeat positioning of duplicate workpieces. The one above was made from a scored tailstock center softened by heating red-hot and allowing it to cool slowly. (A live center needs no annealing). Push it into the spindle and face it off until only ⅛″ projects. Drill and tap for a setscrew, and provide a thin lock nut. Besides acting as a stop, the plug keeps chips out of the spindle taper.—Richard Hanscom.

Milling Long Slots. A narrow saw is apt to wander when milling a long slot, with resulting inaccuracy. To overcome the tendency of such saws to "walk," take a fairly shallow first cut—.030″ to .040″. The saw will not run off during this shallow cut, which guides it for the following heavier ones.—Harold B. Eastman.



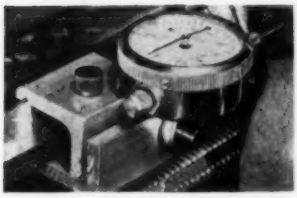


Sensitive Shopmade Indicator Reads Thousandths

REQUIRING no gears or critical machining, this indicator has a range of over .015" plus or minus and can be set up two ways.

Shape the base plate of ¼" cold-rolled steel, clamp the mounting bolt to it with a beveled nut, and secure with solder. Use hardenable steel for the pivot lever, laying out the offsets carefully; these are the centerlines of the ball tips, which should be smooth and polished. Ream the hole a close fit on the pin. Harden all over; then draw to straw color. Solder a bit of jeweler's saw blade in the slot as a pointer.

The spring makes a single loop about its anchor screw, and has a short end that bears against the case. Use a lock nut beneath so the screw doesn't clamp the loop. A cover can be bent from sheet metal. It might be held by prick-punching four spots into dimples in the plate instead of with screws as in the original. The shank is of soft steel, with two mounting holes for the indicator. Set it up to bear against work along the offset line, so that this 1/16" offset is the short side of the multiplying lever. With the cross-feed collar of the lathe, index and lightly punch the graduations. Scratch them as lines radiating from the pivot.—JOHN A. BLAKER.



Indicator Mikes Lathe Carriage Travel

BY CLAMPING a dial indicator on the lathe bed you can gauge tool travel accurately for precision turning and boring. Made of aluminum angle, the clamp won't scratch the ways. Mill or file a groove in the top angle for the V-way and drill it to clear a cap screw. Tap the lower one for this and a second screw to mount the indicator.

Clamps Lock Work on Drill Press

QUICKLY set clamps that both position work and keep it from twisting make drilling safer and more accurate. These clamps consist of bar stock to which slotted members are brazed or welded. The slots should be long enough to permit the bars to touch in their innermost position so as to hold the smallest work likely to be handled. Locking bolts consist of hollow-head cap screws into which wrenches are brazed to form handles. Use washers on the bolts as needed so that the handles clamp tightly when turned out.—E. L. JOHNSON.

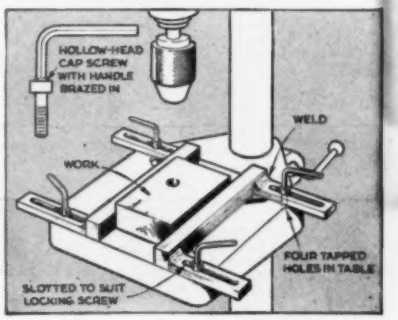
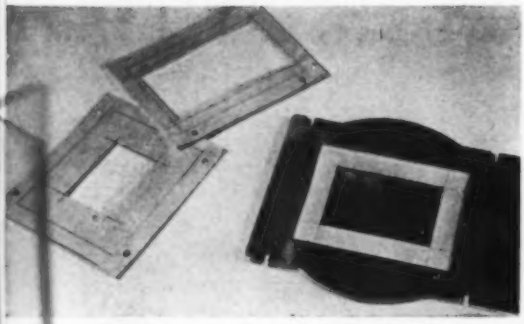
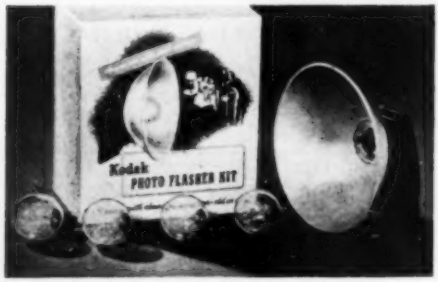


PHOTO IDEAS AND EQUIPMENT

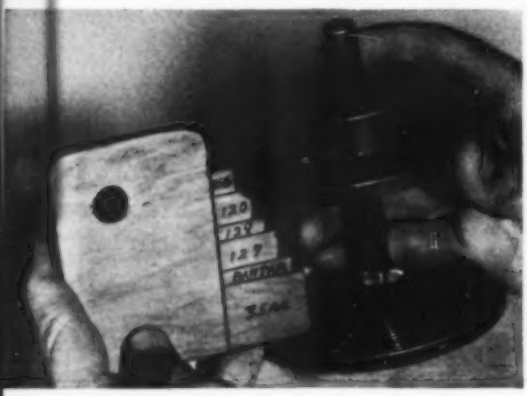
Screw Limits Track Lock. A 2-56 fillister-head machine screw set in the bed of this Speed Graphic limits the forward swing of the track-lock lever and gives finger-tip control. This is especially convenient when a lens of long focal length is used and the lens-board standard partially covers the lever. The screw hole was made with a No. 50 drill and then tapped. In locating the hole center, allowance should be made for the radius of the screw head and the necessary travel of the lever.



Carriers Cut from Folders. An auxiliary carrier to suit a negative smaller than your regular enlarger carrier will accommodate may be cut from an ordinary file folder. Those above were made by placing a folder in the metal carrier and tapping on the pins to "die-cut" the alignment holes. Openings were cut with a knife and ruler.

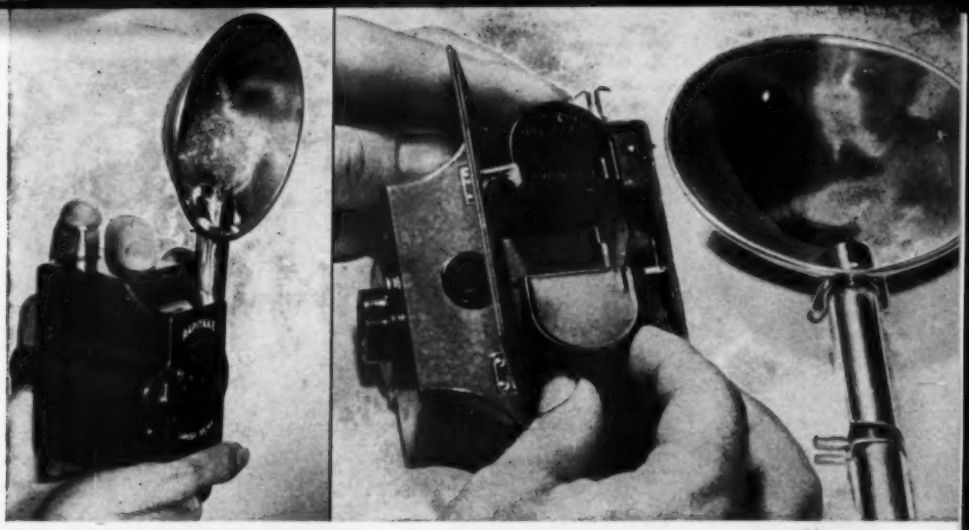


Open-Flash Unit Announced. A new unit designed for open-flash photography is offered by the Eastman Kodak Company. Priced at about $1.25, it consists of an aluminum reflector attached to a compact battery case that also serves as a handle. An ejector button makes it unnecessary to handle hot flash bulbs once the picture has been taken. The flasher requires one C-size flashlight cell and uses either No. 5 or SM bulbs.



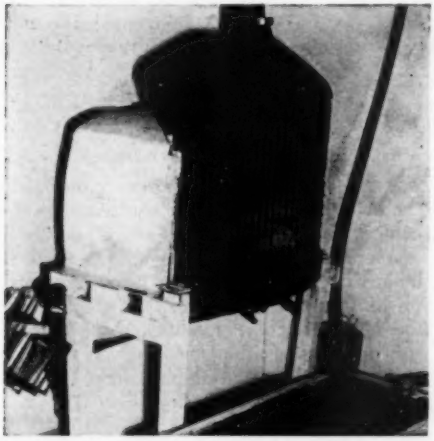
Guide Locates Film Size. If you frequently process roll film of different sizes in your developing tank, a wood guide with stepped notches to suit each film width that the reel accommodates will provide a quick and sure means of adjusting the flange for any desired film.

First, make a cardboard template of the guide by adjusting the reel flange through its full range of stops. Then transfer the outline to ¼" plywood, cut with a coping saw, sand the edges smooth, label each step according to the film size it governs, and apply a coat of clear shellac. A hole bored in the handle will enable you to hang it up with other accessories.



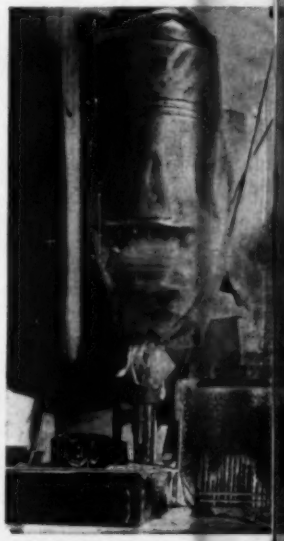
New Camera Introduced. A compact fixed-focus camera with a shutter speed of 1/50 sec. and only one adjustment—a diaphragm having three different apertures—has been developed by Raymond R. LaRose, of Culver City, Calif., designer of the Whittaker Micro 16 (PS, Dec. '46, p. 188). Using 35 mm. film, the new camera has a color-corrected lens, a double-lens viewfinder, and built-in flash synchronization. The same plunger that snaps the shutter also moves the film into position for the next picture, making it possible to take many shots in quick succession.

Called the "Rapitake," the camera was designed to use Ansco Memo film.



Cool or Heat Your Darkroom. An old car radiator that doesn't leak, an electric fan, and a few feet of garden hose will produce excellent results in cooling your darkroom in summer and warming it in winter. Extend one piece of hose from the top of the radiator to the nearest water faucet, and run another from the bottom to the sink. Then place the fan so it will blow air through the radiator. To cool the darkroom, run cold water through the system. To warm it, use hot water.—Fred Dierksmeier.

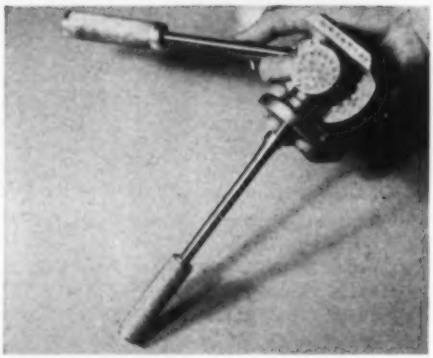
EnlargerCover. A large sheet cut from a damaged plastic shower curtain provides excellent material for an enlarger cover. Drape the material over the enlarger, pin to conform to the shape, and then sew or staple. Turn the resulting cover inside out to hide the stitches, and place a drawstring around the bottom edge so the envelope may be pulled tightly shut while the enlarger is not being used. Close stitching renders the seam dustproof.—Emil Gaynor.



Wetting Agent Avoids Spots. In spite of repeated spongings, water spots sometimes mar an otherwise good negative. These often are the result of extremely hard water, a mineral deposit being left when the water dries. Such spots can be prevented by rinsing the negative briefly in a 1 percent solution of a wetting agent.

One Turn Locks Pan-Tilt Head

By M. C. Anderson



The heavy-duty head will accommodate cameras of any size. Note it has a long tripod screw.

Setscrews riding in ⅛" grooves keep the head members from separating even when not locked.

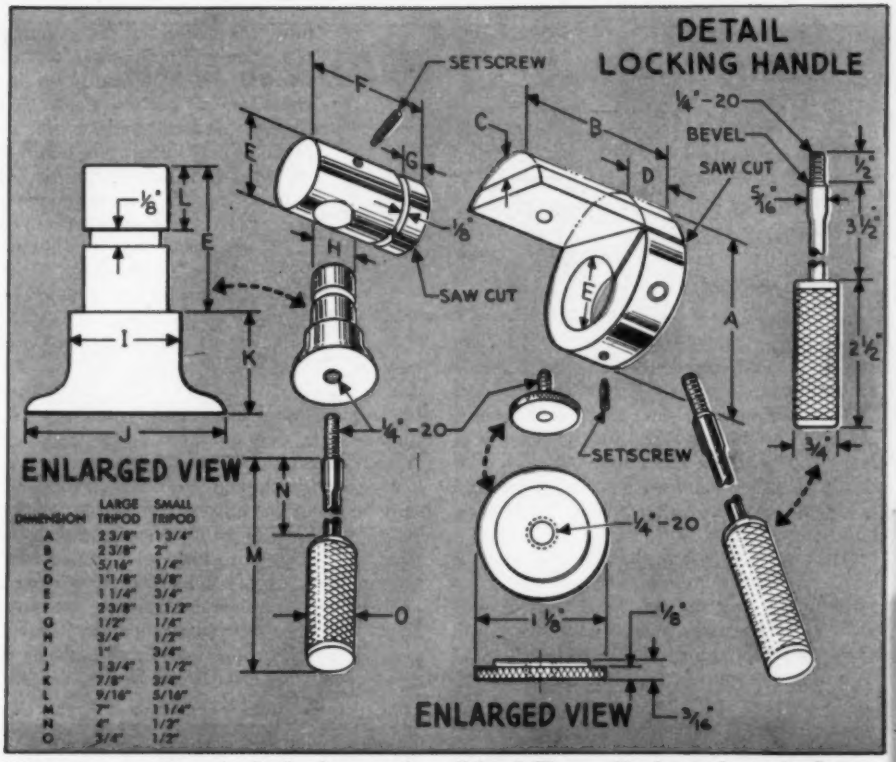
TURNED from aluminum on a small lathe, this tripod head provides both pan and tilt action with one control. It pans through a full 360 deg., tilts 90 deg., and locks securely at any position of pan or tilt by a quarter turn of the handle. Dimensions are given in the table on the facing page for constructing heads of two sizes—one for press and other large cameras and a lighter head for smaller cameras. In either case, the construction is the same.

If aluminum stock of sufficient size is not available, you can melt down a quantity of scrap and let it cool in a tin can. Old aluminum cylinder heads, pistons, household pots and pans, and the like may furnish the metal. The scrap can be melted by placing it in a can over a gas plate and then directing a blowtorch against the can to provide the necessary additional heat.

Saw Cuts Provide Locking

Begin by making the large piece that gives the head its tilt action and also serves as the camera mounting pad. Turn it down to diameter *A* and then face off the ends to length *B*. Next, mount the piece off center in the four-jaw chuck and bore the hole for the horizontal bar. Rechuck at 90 deg. to the previous position and face off the side for the camera mounting pad, removing metal as indicated by the dimension *C*.

The piece is now finished by hand. Remove the surplus metal from beneath the camera pad first, using a hacksaw to make the cuts and finishing with a flat file and emery cloth. Then drill a hole clearance size through the camera pad for the ¼"-20 screw that locks the camera to the pad. Also drill and tap a hole at the bottom to suit the setscrew you intend to use, noting that the setscrew should turn in flush and that it has a turned-down end to ride in the ⅛" groove of the horizontal piece. Now drill a radial hole from the rim toward the center; it

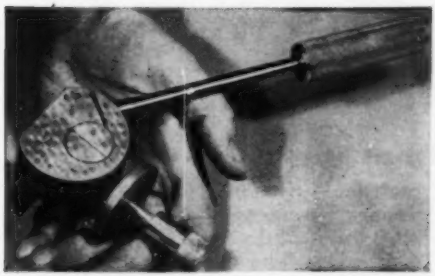


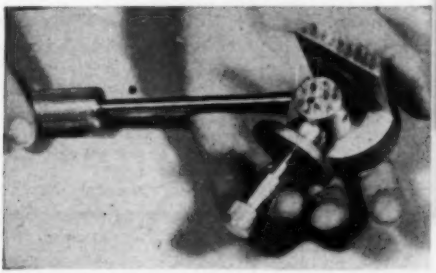
DIMENSION	LARGE TRIPOD	SMALL TRIPOD
A	2 3/8"	1 3/4"
B	2 3/8"	2"
C	5/16"	1/4"
D	1 1/8"	5/8"
E	1 1/4"	3/4"
F	2 3/8"	1 1/2"
G	1/2"	1/4"
H	3/4"	1/2"
I	1"	3/4"
J	1 3/4"	1 1/2"
K	7/8"	3/4"
L	9/16"	5/16"
M	7"	1 1/4"
N	4"	1/2"
O	3/4"	1/2"

Dimensions are given for both a large and small head. The smaller has a short tripod screw.

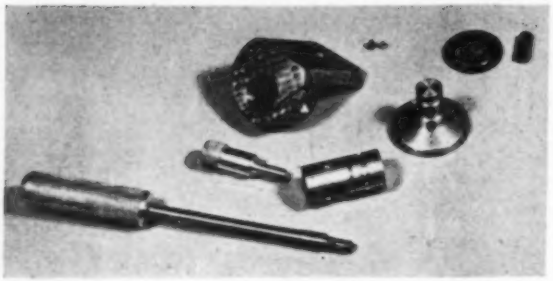
should be at least ½" deep and tap-drill size for the locking handle. Clamp the piece in the vise (use cardboard or other soft material to avoid marking), and carefully cut through the ring with a hacksaw in a plane about 90 deg. to the locking-handle hole. Counterbore the hole clearance size up to the sawcut and tap the part beyond the cut ¼"-20.

The horizontal bar about which the camera pad tilts is a simple turning and drilling job. Turn it to diameter *E* and length *F*, turn the ⅛" groove, and drill the transverse hole. Drill and tap for a setscrew at right angles to and midway of this hole, and then split the end with a hacksaw up to the large hole. Since the clamping action and rigidity of the finished head depend upon accurate fitting, each part should be carefully checked against its mate. It is best that these mat-





Saw cuts in two parts of the head allow one motion of the control handle to lock both the pan and tilt actions. Opposite faces of the small tripod head are seen in the above photographs.



All parts must be a close fit if the head is to work well.

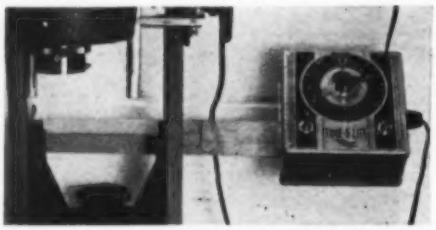
ing parts are a close push fit before the saw cuts are made.

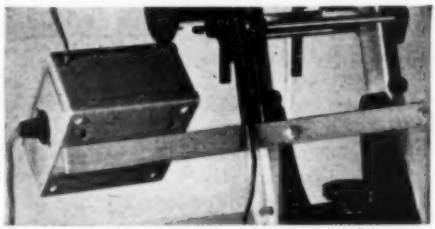
Turn the base to size, face off the ends, and drill the bottom ¼"-20 for the screw that locks the head on the tripod. Notice that this part also is grooved for a setscrew that holds the head together when the locking handle is loosened.

Although the locking-handle grip may be turned from aluminum and then knurled, the rod itself is best turned from steel, since it will receive considerable wear. The entire screw and handle for locking the head on the tripod, however, may be turned from aluminum, for it does not get so much use. You will notice that dimensions *M* and *N* indicate two designs for this bottom screw. Although the long one is easier to reach, it may necessitate removal of the head before the tripod can be closed without marring the legs. A screw of either length might be used for the heavy-duty head. The shoulder at the end of the threads should be square.

A length of ¼"-20 stove bolt may be utilized as the mounting screw. Fit this permanently into the 1⅛" knurled head by brazing, pinning, or simply jamming the threads. The horizontal bar keeps this screw from falling out of the head when not in use.

If you wish, the outer surfaces of the head may be given the whirl patterns of an engine finish. A special rubber-bonded abrasive stick for this purpose may be obtained from a manufacturer of abrasives. However, a very attractive finish also may be produced by chucking a rubber-tipped pencil in a drill press and using it to whirl small pieces of crocus cloth against the faces. END





Timer Mounted on Enlarger Is More Easily Read

VISIBILITY of a timer dial in the darkroom can be improved and its controls can be set more accurately if the timer is mounted on the enlarger as illustrated above.

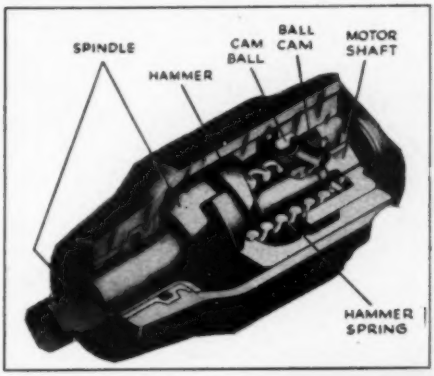
The bracket was made from a 1" by 1½" by 16" wood strip, 8" of one end being beveled so the timer could be faced upward at about 45 deg. Notches were cut in the front of the bracket to fit it around the enlarger casting, and it was attached to the guide rails by drilling and tapping the latter for 10-32 machine screws. The timer is held to the bracket by two wood screws placed through holes drilled in its back. Another type of enlarger would of course require different treatment—GLENN A. WAGNER.

Glossy Prints Ferrotyped on Sheet Cellulose

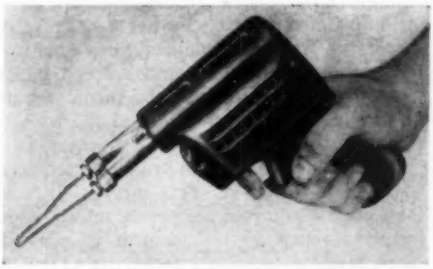
THIN cellulose acetate sheeting rivals chromium plates as a means of ferrotyping glossy prints. Relatively inexpensive, this clear cellulose may be obtained at stationery stores in 20" by 50" sheets.

Both sides of the sheeting may be used repeatedly. Ferrotyping is done in the usual manner, but intense heat should not be applied for rapid drying. Because of its lightness and small bulk, a roll of the sheeting is a handy accessory for a traveling photographer.—JACK WILSON.

NEW TOOLS

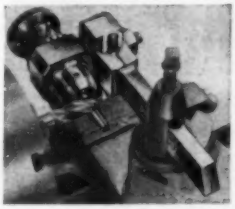


Impact Tool. Until resistance to rotation reaches a certain point, a tool made by Ingersoll-Rand Co., Phillipsburg, N. J., runs like an electric drill. Once resistance on the anvil (or spindle) is greater than spring pressure, the anvil remains stationary while a rotating ball cam pulls the hammer back, compressing the spring. As the cam balls reach the lower part of their track, the hammer delivers a rotary impact on the spindle, 1,900 times a minute. The tool can be used to drive nuts, tap, ream, and drill masonry. Various attachments are offered.

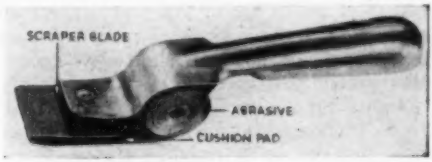


Soldering Gun Has Light. A small lamp lights the work when this soldering gun is switched on. The loop tip is at soldering heat in five seconds, and draws current only in use. Containing a built-in transformer, the gun is a product of the Weller Mfg. Co., of Easton, Pa.

Milling Done on Lathe. This indexing work holder makes it possible to use any lathe as a milling machine for bar stock up to ¾". Mounted in the tool post of the lathe, the attachment provides full 360-deg. rotation in three directions—radially, vertically, and horizontally. Hence the work can be set at any angle. The radial adjustment is indexed to 24 divisions, set by a screw and locked by a key. Davos Products Co., of Chicago, is the manufacturer.



Vise Also Used as Clamp. Supplied with bars of two lengths, a combination tool made by the C. G. Schulze Co., of Los Angeles, serves both as a vise and as a bar clamp, the jaws being quickly changed from one bar to the other. As a vise, the tool may be used free or bolted to a bench, clamping pressure being applied by a toggle lever. As a clamp, the movable jaw may be set at 4" intervals to a 68" maximum.

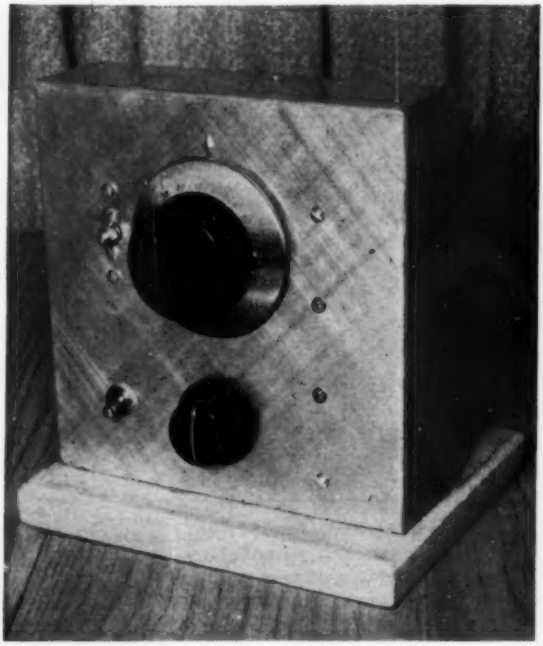


Sander and Scraper Combined. A combination sander and scraper made by the Glober Mfg. Co., Chicago, has a roll of 1" wide abrasive that may be fed to the sanding area as the old part becomes worn. A setscrew holds both the abrasive and the scraper. The latter slides out when needed.

Short-Wave Converter Brings in the World

Operated with your regular broadcast receiver, this one-tuber will cover the major foreign wavelengths.

By S. T. Van Esen, W2OXD



Standing on end, the chassis becomes the front panel. The larger knob governs the oscillator condenser; the small one the mixer. Finish is obtained by drawing steel wool along a rule.

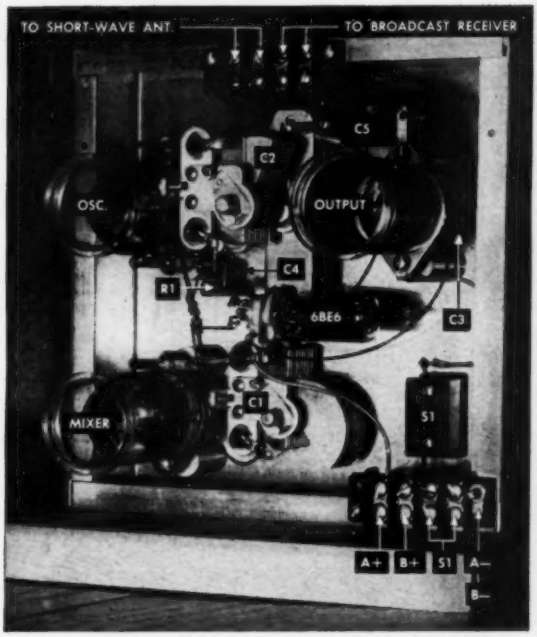
LONDON is calling. Lima, Sydney, and Johannesburg, are on the air too. There's a wealth of news, information, and entertainment pouring out of foreign skies, just waiting for you to listen in. If you've been wanting to do just that but have hesitated because of the difficulty of building a short-wave receiver from scratch, here is your answer. It's as simple as one tube and a few coils. The rest is already built into your regular radio.

A superheterodyne will give best results, but most radios are of this type. These as well as most other kinds of receivers have everything you need for short-wave reception except that their antenna circuits are designed for a lower frequency. All you have to do is change the short waves into longer ones that can be detected by the broadcast receiver.

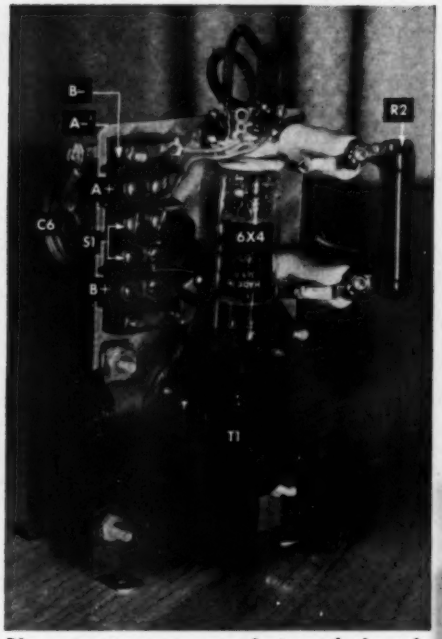
A converter that will do this job consists of a single tube of the pentagrid type operated in conjunction with suitable coils and capacitors. Two things should be noted about this tube: first, it is actually two tubes in one, and second, it has five grids. For simplicity, only three of them are shown in the diagram; the suppressor and one of the screen grids are omitted since their connections are made internally.

One section of this tube is called the "mixer" because the incoming or short-wave signal applied to its grid or input circuit is changed to broadcast frequency in the plate or output circuit. The other section, the "oscillator," may be visualized as a miniature transmitter. It produces a signal voltage of its own that is applied to the mixer circuit simultaneously with the desired short-wave signal.

Now let us say that the broadcast receiver is tuned to 1,500 kc. (1.5 mc.). We will then want the mixer to operate only at this frequency—that is, we want it to convert every short-wave signal within its range to 1,500 kc. To do this the oscillator must be tuned 1,500 kc. higher or lower than the incoming programs. For example, to get a foreign station broadcasting on the 6 mc. channel, we tune the oscillator to 6 plus 1.5, or 7.5 mc. By combining or "beating" the two signals together, we obtain the 1.5 mc.



Coil sockets and the oscillator capacitor are raised from the chassis by insulated spacers. Solder all leads that go beneath these parts before you actually fasten them into position.



If a separate power supply is used, the only connections to the receiver will be those for antenna and ground. Alternatively, plate and filament voltages can be tapped off an AC set.

difference that can then be applied directly to the input circuit of the broadcast receiver.

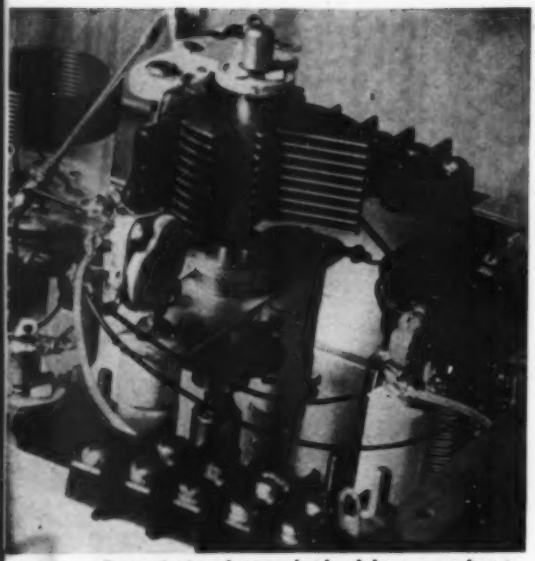
In this converter the critical tuning is done by the oscillator capacitor, C2. As we rotate the dial through its range of frequencies, any signal that is *lower* than the oscillator setting by exactly 1.5 mc. will be heard in the loudspeaker of the broadcast receiver. Strictly speaking, "image" signals exactly 1.5 mc. *higher* should also be heard, but since the mixer tuned circuits are adjusted for best response to the lower frequency, the latter will probably come in much stronger.

A 2″ by 7″ by 7″ aluminum chassis doubles as the front panel. Aluminum is a good choice because it can be worked without special tools. If reasonable care is taken to keep from scratching the face, it will be possible to apply an attractive cross-grain finish by pulling a small wad of steel wool against a straightedge.

Sockets for the three plug-in coils are mounted 1⅝″ off the chassis. Common ceramic stand-off insulators 1″ long were used. (They are ⅜″ in diameter and tapped at both ends for 6-32 machine screws.) The extra spacing was obtained by adding lengths of ¼″ aluminum tubing to the end of each insulator.

Because the type of vernier dial used has a protruding hub, the main oscillator tuning condenser also had to be spaced away from the chassis. Ceramic insulators were used here too with a metal strip bridged across them to support and ground the rotor. Details of this construction are shown in the closeup photo on page 220. The holes through which this bridge strip is fastened to the insulators are slightly elongated so that the tuning shaft can be aligned, and a flexible coupling is used to link it to the dial hub.

The tube socket, mounted to hold the 6BE6 horizontally, has a metal ring that allows it to be attached to one of the ceramic supports by means of a 6-32 spade bolt. A midget variable capacitor, used to tune the output coil, is placed directly beneath the coil socket. If there is not enough clearance between socket and capacitor, use longer aluminum spacers. Bear in mind that while the capacitor mounts directly on the chassis,



Ceramic insulators, bridged by a metal strip, hold the oscillator condenser off the chassis. The midget tuning capacitor, C3, may be seen at the right, under the output-coil socket.

LIST OF PARTS

C1, C2: 140-mmf. variable capacitor (Hammarlund type MC-140M).

C3: 75-mmf. midget variable (Hammarlund type APC-75).

C4: 50-mmf. midget mica.

C5: .01-mfd., 400-volt paper.

C6: 18-18 mfd., 450-volt dual electrolytic.

R1: 20,000-ohm, ½-watt carbon.

R2: 30,000-ohm, 10-watt wire-wound.

S1: SPST toggle.

T1: power trans., primary: 115 volts; secondary: 700 volts (at 50 ma.) centertapped, and 6 volts (at 2 amp.).

Coil forms (3) 5-prong, 1¼"-dia. polystyrene (Amphenol type 24-5P).

Coil sockets (3) 5-prong.

Tubes, 7-prong miniature sockets, chassis, knobs, misc. hardware.

it has a high voltage at both ends and therefore must be electrically separated from the chassis. Mounting inserts are insulated, and the hole through which the shaft projects must give adequate clearance.

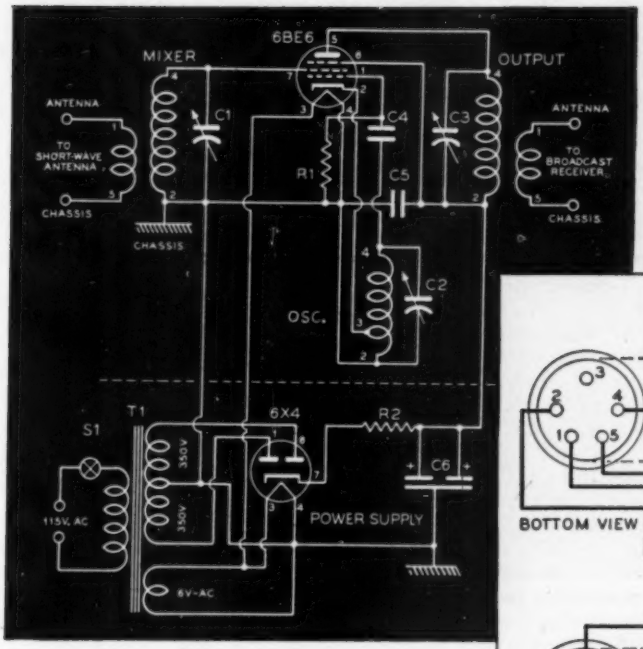
Input and output signal leads are brought to a terminal strip on the rear top edge of the chassis; power connections center in another block at the lower edge. Power for the converter can readily be taken from most AC receivers, but where proper voltages are not available (on some AC and all AC-DC sets) it is advisable to construct a separate power supply. This will have the additional advantage of making the unit completely self-contained.

The photo of the power supply shows how the long bolts that hold the transformer-core laminations are used to support an aluminum panel upon which the rectifier tube (6 X 4), the filter capacitor, and the filter resistor are mounted. The switch could have been mounted here rather than on the converter, but the arrangement shown was found more convenient in use, and it also lessens the danger of shock by making it unnecessary to handle the high-voltage supply once it is connected.

While considerable leeway is possible in the arrangement of wiring and components, the coils *must* be as specified if proper results are to be obtained. They are worked out so that, when tuned with the capacitors specified, they will operate properly over a frequency band ranging from approximately 6 to 16 mc.

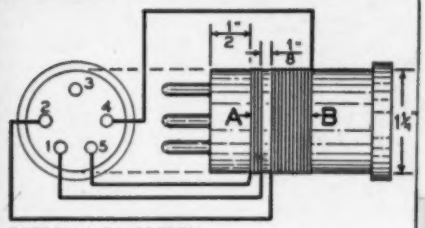
Connect the antenna terminal of the broadcast receiver to the converter; if no ground connection is provided on the receiver, wire the other end of the output-coil secondary to the chassis of the receiver through a .01-mfd. condenser. Remember that on some sets the chassis is "hot." Now set the dial of the broadcast receiver to 1,500 kc. If you get interference at this point, turn the dial slightly (toward the high-frequency end, if possible) until you have tuned out the interfering station.

For good long-distance reception, an outdoor antenna about 40′ long should be used, although in actual tests this converter gave good results with a short indoor aerial. Connect it to the proper input post, leaving the ground lead open for the moment. Turn on the power for both sets and adjust the receiver volume control for maximum gain. Starting at the lowest frequency on the oscillator dial (plates completely in mesh), slowly rotate the knob until some signal is heard. It doesn't make any difference what the



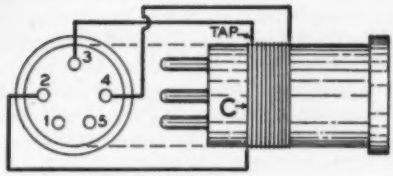
Schematic diagram shows how to wire the simple one-tube converter and its power supply. If possible, follow the parts layout shown in photos, keeping all signal leads short.

Coils are critical. Make sure that the forms are the right size and that wire and number of turns are exactly as specified. They are calculated to cover the 6 to 16 mc. bands.



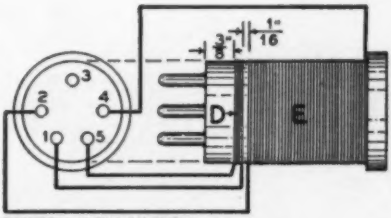
BOTTOM VIEW OF FORM

MIXER COIL



BOTTOM VIEW OF FORM

OSCILLATOR COIL



BOTTOM VIEW OF FORM

OUTPUT COIL

signal is so long as it is steady enough so that you can use it to peak the converter. With a fiber wand, carefully rotate the midget capacitor C3 until the signal reaches maximum strength. Now rotate the mixer control, C1, until the test signal is again brought to maximum. The ground lug adjacent to the antenna input terminal should now be touched to the chassis to see whether this increases volume; if it does, make a permanent connection.

Once these preliminary adjustments have been made, do not touch C3 or the dial of the broadcast receiver. Change stations by rotating the oscillator capacitor, and then peak the signal by careful adjustment of the mixer control.

Image signals may cause the converter to bring in the same station at two different settings of the oscillator dial. To tell which is the correct position, look at the plates of the oscillator and mixer capacitors. They should be in or out of mesh to about the same extent. However there's no harm done if you peak up on an image rather than a true signal except that dial settings will be out of proper sequence.

The range of the converter includes a majority of the international broadcast bands as well as many amateur transmissions. END

COIL DATA

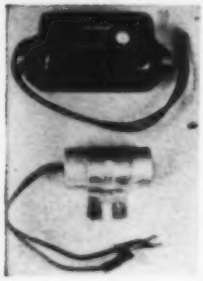
All turns close wound with plain enameled copper wire; sizes as given below.

Mixer Coil:
A: 3 turns, No. 18.
B: 11 turns, No. 18.

Oscillator Coil:
C: 10 turns, No. 18; tap 1 complete turn up from bottom end.

Output Coil:
D: 5 turns, No. 26.
E: 87 turns, No. 26.

Quickly Installed Filters Cut Fluorescent-Light Static



THE cool, efficient illumination that you get from fluorescent lights is almost matched on the debit side by the static they cause in radio and television receivers. If you have installed any of these new lights you can do yourself and your neighbors a favor by adding line filters. Many condenser manufacturers produce filters that keep the high-frequency disturbances out of the electrical wiring system by by-passing them to ground.

A typical unit—the smaller one in the photo above—consists of two capacitors connected in series with the center part grounded to the case. When the leads are wired across the line and the mounting bracket is bolted to the lamp reflector, both conducted and radiated interference are sharply reduced. A separate filter should be used on each fixture, and for multiple units a larger filter (top) is recommended; it is connected in series with the 115-volt line. It is advisable to use the larger-capacity type if a television set is in operation since it protects the video as well as the broadcast frequencies.

Clamps Steady Radio on Bench

COILS or tubes are sometimes damaged when a radio chassis is placed on the workbench for servicing. To keep weight off these parts and lessen the chance of breakage, attach one or two C-clamps as shown to support and steady the set.—H. LEEPER.

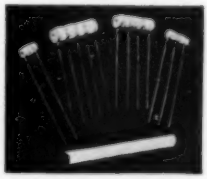
Tape Shields Tube Numbers

EXPERIMENTERS who keep a supply of tubes on hand often find it impossible to identify some because the type numbers have been worn away through handling. This won't happen if you put clear cellulose tape over the number when the tube is new.

Floating Arm Adapted to Mike

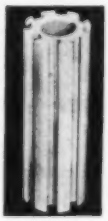
GETTING a microphone into the desired position quickly is no problem with this completely flexible arm that moves in any direction and stays exactly where you put it. Long in use on desk lamps, it is now made available with mike fittings by Dazor Manufacturing Corp., St. Louis.

Tiny Resistors Are Accurate



MINIATURE precision resistors, built to a standard tolerance of 1 percent, have been announced by the Shallcross Manufacturing Company, Collingdale, Pa. The smallest single unit is 15/32" long. Other types with two to four sections have also been produced.

Form Is Easily Tapped



A FLUTED coil form made by Henry L. Crowley & Co., Inc., West Orange, N. J., eliminates the need for special holes and will take a tap from any part of a winding. Matching terminal clips and bases are available.

Cabinet doors and hinged drawer front reveal—or conceal—the radio and slide-out changer.

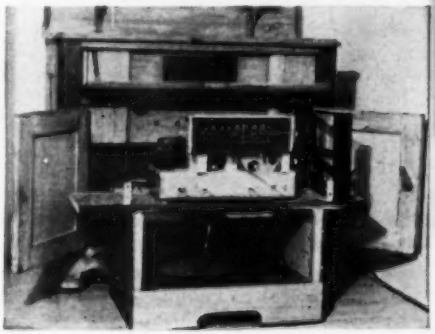
Pine Washstand Holds Phono-Radio

A RADIO and phonograph console that harmonizes with pine furnishings isn't easy to find in the music shops, but its parts can be assembled without great difficulty. This unit was put together at a fraction of what the complete set would cost, and it has become the showpiece of the room.

Better-than-average radio equipment was bought new; the cabinet is a colonial washstand that was picked up at a bargain because it needed refinishing. The photos above show two views of the completed set, and at the lower right you can see the cabinet with the works removed. All parts are accessible for repair.

The face of the drawer above the doors was hinged at the bottom; it drops flat to expose the dial. A supporting frame was built for the record changer, and the unit mounted on slides so that it can be withdrawn for loading and unloading. The ball-bearing slides for this purpose may be purchased at a hardware or radio-parts store.

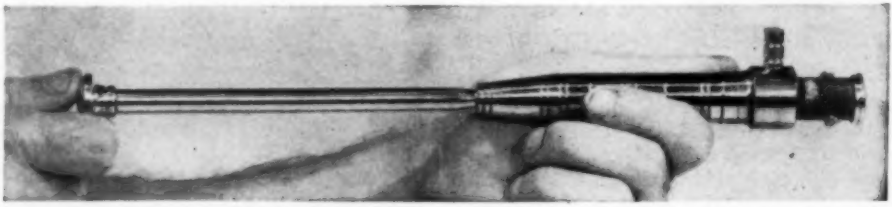
Although there is ample room for a speaker inside the stand, the existence of a very suitable alcove made possible the arrangement pictured at the left. A shelf was built across the upper part of the recess in which the console stands; the speaker was baffled into this space, and a short drape hung in front of it. The extra room in the cabinet is utilized for record storage.—JACK McGHIE.



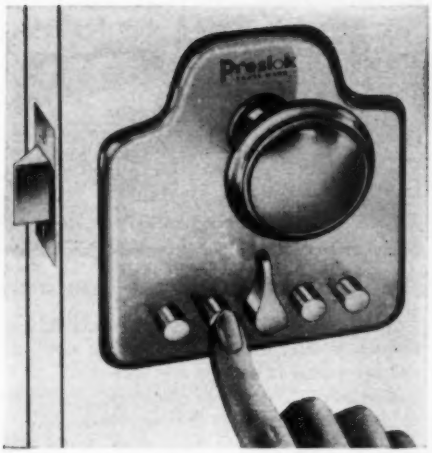
The Mail's Here! An attachment for rural mailboxes offered by the Tell-O-Mail Company, of Portland, Ore., automatically signals the arrival of mail. When the mailman opens the box door, a connection trips a trigger on the rear, allowing a spring to throw a yellow disk above the box. When the box owner comes for the mail, he snaps the disk down again, ready for the next delivery. The attachment sells for about $3.

Brush Holder Also a Funnel. Fitted snugly on the rim of a paint can, a device produced by the B & W Manufacturing Company, of Indianapolis, serves both as a brush holder and as a pouring funnel. Plated to prevent rust, the holders are available in sizes to suit either quart or gallon cans. The retail price is about 20 cents.

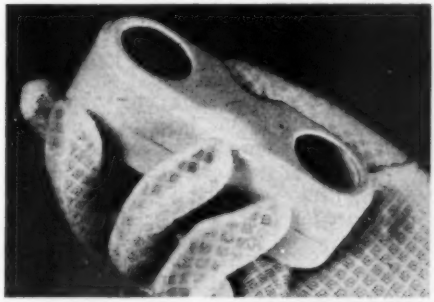
Tile Needs No Cement. Anyone can tile a room with a new type of plastic tile produced by the Pittsburgh Tile Company, Pittsburgh, Pa. These tiles are joined by a tongue-and-groove type lap joint and do not have to be filled in with cement, the self-aligning joints being watertight. Adhesive is used to attach the tiles to a wall.



Lighter Helps Start Fires. The ordinary cigarette lighter has now been adapted for use in kindling a fire in your fireplace. Crescent Industries, of Detroit, offers the lighters in 12", 24", and 30" lengths at prices from $3.75 to $8.75. Sliding the barrel strikes a spark, igniting four wicks. Any lighter fluid may be used.



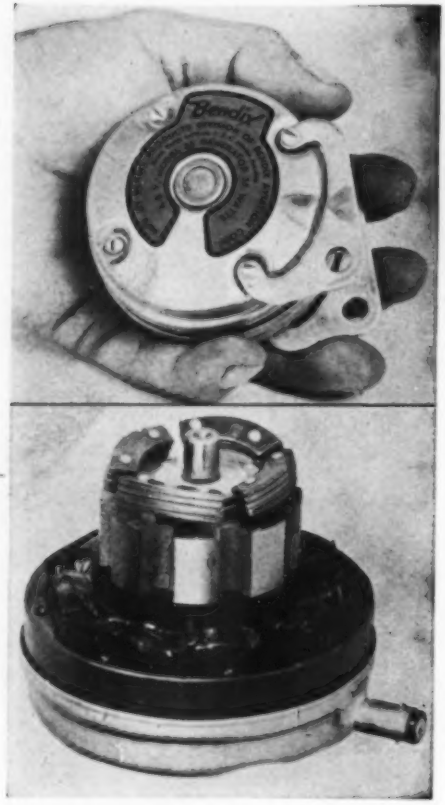
Lock Works on Combination. To open a door equipped with a new keyless lock made by the Security Lock Corporation, of Walden, N. Y., you must know the combination. It locks when the center lever is flicked, but to open it you must tap out the proper combination on the four buttons. The lock has virtually unlimited combinations, and it's built so you may easily change the combination whenever you see fit.



Glasses Fold. For carrying, these binoculars fold into a compact 1¼" by 1¼" by 4" size, easily placed in your pocket. When opened for focusing, they extend from 3¾" to 4". A product of the Porto-Sight Company, of Kansas City, Mo., they weigh less than 2 oz., have an optical power of 3, and, except for the folding mechanism, are made entirely of plastics—including the lenses. They are available in either black or ivory for about $2.

Valve Regulates Heat. A steam radiator valve that automatically controls the temperature of each radiator on which it is placed is being marketed by the Heat Timer Corporation, of New York City. Installed in place of the ordinary air valve, the new one has a movable indicator on a scale of temperatures. A thermostat inside keeps the valve closed as long as room temperature remains at the desired level.

Scissors Run by Electricity. The vibrating jaws of electric scissors made by the Atlas Instrument Co., Haddonfield, N. J., will cut fabrics ranging from several thicknesses of woolens to fine cottons or silks. Controlled by pressure on a button, the device can be guided around intricate curves as well as in a straight line. With a 6′ cord and a leatherette case, the unit sells for about $10.



Lamp Magneto Governs Itself

A COMPACT magneto to supply current for lights on motor bicycles and scooters is self-regulating, keeping output uniform from idling to maximum speeds. Driven from the engine flywheel or a tire, the rotating member is an Alnico ⓣ magnet with eight poles, turning inside eight stationary coils.

Four laminated segments are attached to the rotor by separate leaf springs of different strength, which at low speeds hold them clear of the magnet poles. As speed increases, one segment after another flies against the magnet poles, each bridging a pair. This progressively "short-circuits" the magnetic field, holding current output constant despite higher speed.

The compact generator is only 1½" thick and 3½" in diameter, and develops enough power for a 30-watt sealed-beam headlight and a taillight. Made by a division of Bendix Aviation Corporation, South Bend, Ind., it is available only to manufacturers.

Air Pistol Is Breech Loading

SAID to have enough muzzle velocity to form a 1" test grouping, at 30', a new target air pistol is cocked by "breaking" it to draw back a spring-driven piston. Two calibers are available for shooting .177 or .22-cal. pellets, both priced at about $20 with ammunition and targets. The gun has a rifled barrel, and ammunition is loaded into the breech. Hy-Score Arms Corp., Brooklyn, N. Y., are makers of the air pistol.

Removing Tape from Skin

ADHESIVE tape commonly leaves stubborn traces of itself on the skin after it's peeled off. Alcohol or turpentine will get them off, but if neither is available you can use the tape itself, sticky side out, like an eraser to rub off the clinging bits.—H. SAMUELS.

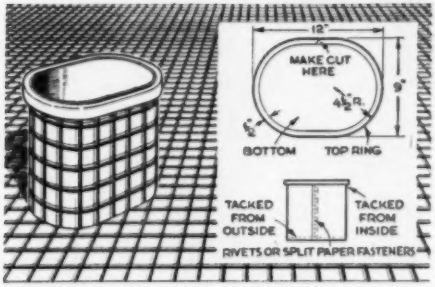
Spaces Let Subflooring Expand

DRY subflooring will become swollen if a prolonged rain occurs before the roof has been put on a new building. The tremendous pressure developed can cause serious displacement of walls and partitions, unless spaces are left to let subflooring expand.

One way of leaving such spaces that makes it easy to fill them in after the roof is on, and the danger of swelling is past, is to lay in common one-by-twos temporarily. Simply insert one between every seven or eight boards when laying the floor, and remove until the roof is on. Later, nail them.—J. MODROCH.

Spool Helps Clean Bike Chain

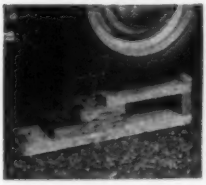
To CLEAN a bicycle or motorcycle chain thoroughly, in even a small can of fluid, push a big nail through a wooden spool and drive it into a wall or post a bit higher than the doubled chain's length above the floor. With the master link reconnected, run the chain over the spool through the fluid.—JIM POOL.



Wastebasket Matches Floor

SCRAPS of linoleum and a 9" by 12" piece of ¾" wood make a surprisingly sturdy wastebasket. The one I built will readily support 170 lb. The wooden parts are cut as shown—first the outside contour, then the top ring, which leaves the bottom. Other shapes can be made the same way. Use small tacks in fastening the linoleum to the ring so as not to split the wood. A dab of glue in the joint will reinforce it, and the ring can be painted a trim color for decorative effect.—JOSEPH R. ZEBROWSKI.

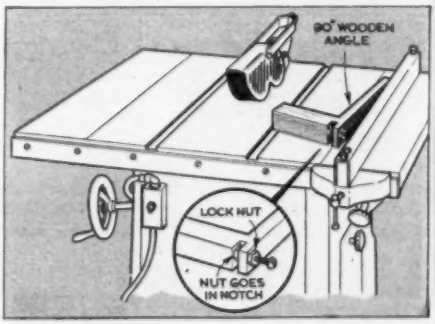
Blocks Raise Car for Mechanic



NAILED together from short lengths of two-by-eights, two of these blocks provide a car support you simply drive up on. The base is 26" long. Each step is set back 4", the top being 14" long. The single end support equals the height of the two center lifts. Nail on a strong stop cleat, and don't forget to chock the other wheels securely both fore and aft when the car is up on the blocks for work.

Router Ground from Old Drill

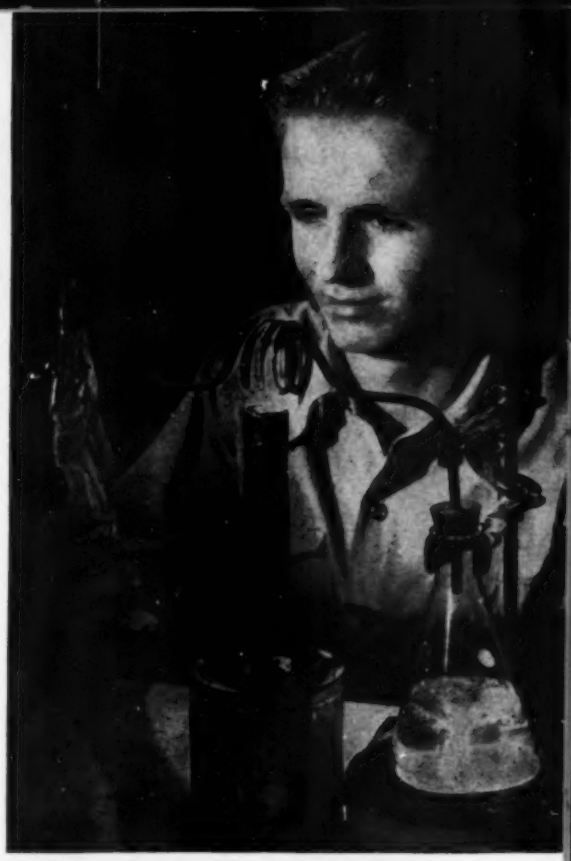
NEXT time you wish you had a round-bottom router, why not make one? All you need is a broken drill about ½" in diameter. Break or grind it to half its original length. Then rough-grind the end round, without any cutting-edge clearance as yet. Chuck it in a lathe or drill press and with a coarse oilstone finish rounding the tip evenly. Then go back to the grinding wheel and carefully grind clearance back of each cutting edge without changing the spherical shape. You can use the router freehand to rough out hollow parts in carved trays and similar pieces, or with a fence on the drill press for forming decorative grooves.



Angle-Sawing Jig is Variable

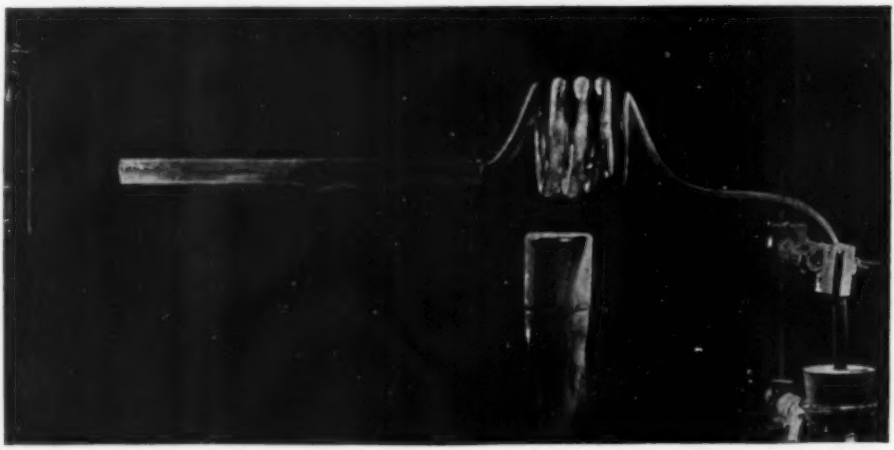
THIS improved jig for cutting wedges and short tapers is adjustable for various angles. Glue it up of several pieces of hardwood with the grain crossing for ample strength in the corner. The far tip and the bolthead slide against the fence.

Steam That's Hot as Fire



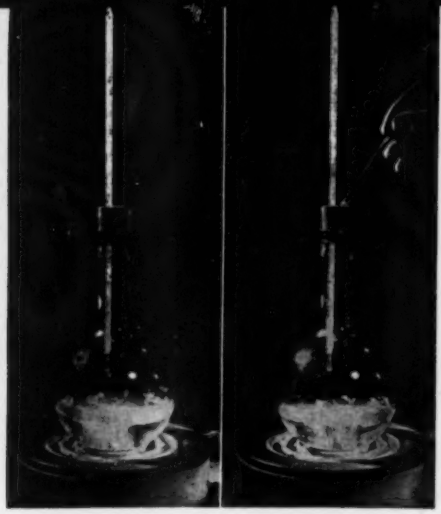
It Ignites Paper and Wood. You may think of steam as being wet, like water, and therefore likely to keep things from burning, but true steam is actually dry. Under conditions of increased pressure or superheating it may be hot enough to ignite wood or paper and melt lead.

Some of the properties of superheated steam may be demonstrated with a home-made superheater coil. Near one end of a 36″ length of ¼″ copper tubing form a coil of four turns 2″ in diameter. Insert the long end of the tubing through a one-hole stopper in a flask containing water, heat the water to boiling, and place a Bunsen burner under the coil. When the coil is heated strongly, the completely invisible steam pouring from the tube will make a piece of wire solder flow like water or, as shown here, will char and even ignite a scrap of paper.



Magnesium Burns in Steam. Magnesium is such an active metal that it can break down steam into oxygen and hydrogen, and burn in that atmosphere. To demonstrate, press a 6″ piece of Pyrex tubing, just slightly larger than the copper tubing, over the nozzle of your superheater and place a 2″ length of magnesium ribbon inside. Then, while boiling the water, heat the coil vigorously and also apply a flame under the magnesium, either using two Bunsen burners or moving one back and forth. The magnesium will soon burn as brilliantly as it would in the open air.

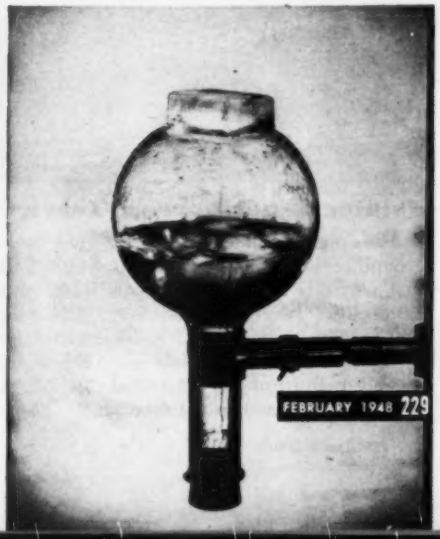
Real Steam Is Invisible. You have never seen real steam, and you never will, for it is completely invisible. The cloud that issues from your coil when it is not heated actually has already condensed into tiny water droplets. But very close to the nozzle the steam is still hot enough to remain gaseous and invisible. Heating the steam in the coil as in the lower photo keeps it gaseous longer, but you can prove it's there—and change it to water—by placing a cool pie plate in its path.



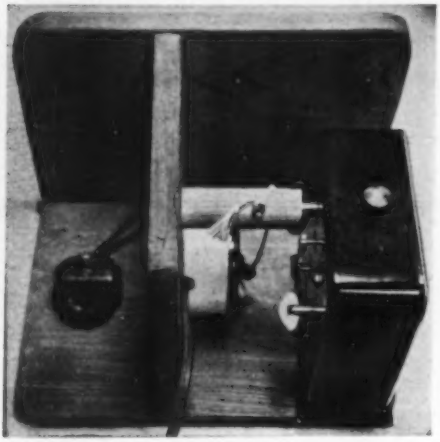
Steam Temperature Varies. The temperature of steam produced in an open pot depends upon atmospheric pressure. If the pressure is increased, the temperature goes up accordingly. This may be demonstrated as above. When water in the flask is boiled rather slowly, a thermometer placed through one hole of a two-hole stopper, as at the left, will register the normal boiling point. If you cautiously close the other hole for just a second or two with a glass rod, the temperature will rise.

Solids Raise Boiling Point. The temperature of water can be raised above its normal boiling point by dissolving solids in it. Acids and common salt will raise the boiling point even more than such things as glycerin and sugar. You can easily demonstrate this temperature rise, and the differences in the rise caused by different substances, by adding samples to boiling water with a thermometer in it.

Pressure Affects Boiling. How a drop in pressure lowers the boiling point may be demonstrated as below. Half fill a small flask with water, boil it vigorously, remove the heat, and stopper the flask immediately. Then support the flask in an inverted position and place an ice cube on its bottom. By condensing the steam, the ice produces a partial vacuum in the flask. Under the low pressure, the water boils again.



Rotating Dowel Flips Switch When Clock Rings

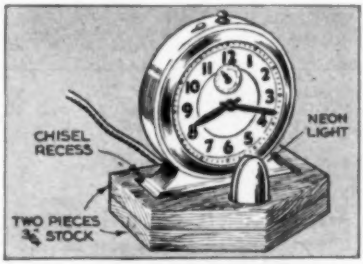


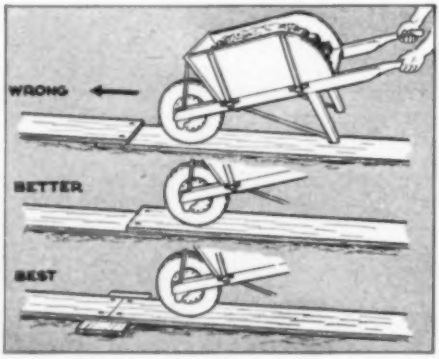
No ALTERATION need be made on the clock used in this time switch, and it is readily removed for use elsewhere. Its only connection is through a slotted dowel that engages the alarm-wind key. A wooden rack may be made to any size that permits the proper relation of switch, rotating dowel, and alarm key. A flush-mounting toggle switch was used, the plastic lever being drilled to receive the wind-up cord.

Slot one end of a ¾" dowel so that the alarm wind fits in freely. Mount the dowel free to turn. I bushed the wooden upright with a piece of copper tubing, inserted a 2½" wood screw as an axle, and turned this tight in the dowel. Even a weak alarm will operate the switch because of the winch effect provided by the dowel.—JOHN WALTERS.

Neon Light Illuminates Clock Face

BETTER than a luminous dial, this stand will enable you to tell time without fumbling for a switch. Two 5" by 6" pieces of ¾" wood are cut to the shape shown, a ¼" recess for the clock is chiseled in the top, and a passage for the cord routed in the lower piece. Drill a centered hole for a flush-mounting receptacle. A metal shield is bent over the front of the neon night light, which takes so little current a switch is unnecessary.—DORIS ANDERSON.

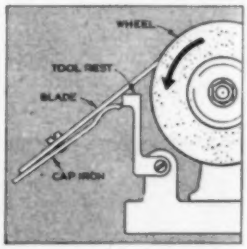




Joining Wheelbarrow Tracks

FOR pushing a wheelbarrow over soft ground, even for short distances, you'll find that you can move bigger loads faster and easier over boards. Make sure, however, that they are joined properly. If loaded barrows move in one direction only, either the second or third of the illustrated methods is satisfactory.—HANS SCHMIDBAUER.

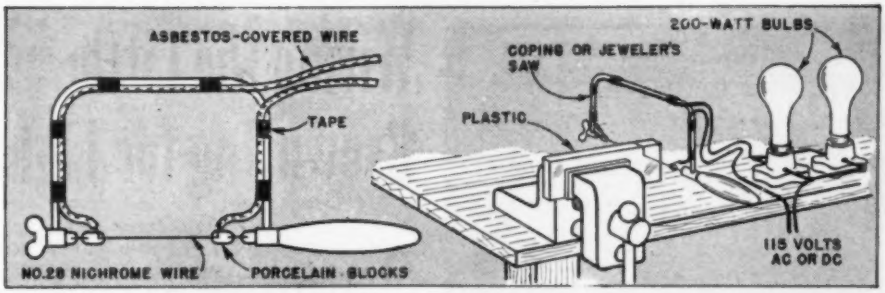
Cap Iron Sets Grinding Angle



USING a hand grinder, I found it difficult to hold a plane iron steady at the proper 25-deg. angle on the tool rest. By reversing the cap iron and adjusting it until the bevel lies flat on the wheel, however, I can always maintain the position, or regain it after dipping the blade in water.—JOHN CONJURSKE.

Glue and Water Clean Paint

ANIMAL glue is an excellent woodwork paint cleaner. Mix ½ lb. in 2 qt. water, and let it stand overnight. Boil and stir for ten minutes. Use a cup of it mixed in a small pan of water. Do not rinse off; the size left replaces gloss that washing dims.



Thermal "Saw" Melts Its Way Through Plastics

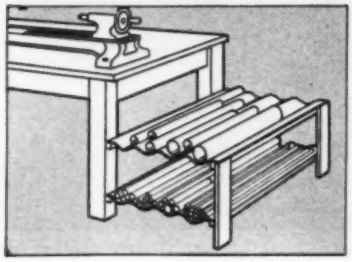
CRAFTSMEN and hobbyists who work in plastic will find use for this saw that gets its muscle from a hot wire. Actually it melts its way through the material, and since it works equally well in any position, curves, circles, and angles may be fashioned more easily than with a blade.

The 6″ of No. 28 resistance wire used in the saw is connected in series with two 200-watt bulbs in parallel. Four 100-watters can be substituted. Other types of resistance wire may also be used, but if changes are made, try various bulbs until you find the combination that cuts well without getting the plastic so hot that it fuses together behind the blade.—STANLEY J. DRAZEK.

Model of Mine Layer Takes People for a Ride

STROLLERS along a towpath that follows England's Thames River occasionally have to look twice before they believe what they see: a punt load of people being hauled by a chuffing model boat. Sprawled in the prow guiding it is its builder, A. E. Squire.

Mr. Squire's 5′ 6″ model of a Royal Navy B-type mine layer has a twin-cylinder, single-acting engine with an overhead slide valve. Its burner is fired with gasoline, and the fuel pump is submerged in the tank. When running under load, the engine will do 3,000 r.p.m., good for about 10 m.p.h. against the current.—A. R. PEERS.



Corrugated Iron Holds Round Stock

SMALL lengths of round stock can create a hazard around the shop if they are just left to kick around or even if they are placed on the flat-racks you use for other materials. By securing a sheet of corrugated iron across the posts of a material rack, however, you can keep them around safely and within easy reach. A smaller piece of the iron should also be set up near the machines on which you most frequently use the stock.—JO RO JUNG.

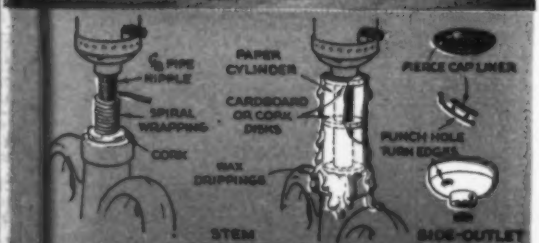
Wiring the Little Brown Jug for Light

ANY decorative jug or bottle may be converted into a lamp base by the procedure outlined here. A hole for the cord may be cut in a pottery jug with an electric engraving tool. Chip the surface gradually from an area ¾" in diameter, avoiding heavy pressure. Once a hole is through, nibble the edges to enlarge it. Then insert a rubber grommet.

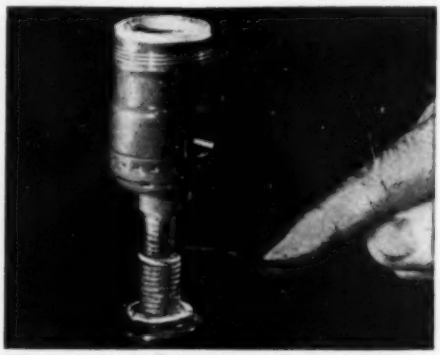
In glass, either drill a hole with a brass or copper tube and abrasive powder (PS, Aug. '47, p. 205) or use a side-outlet socket. If you can't buy such a socket, one can be made by punching a hole in the cap of an ordinary one. Be sure to turn back the sharp edges or make the corresponding hole in the fiber cap a bit smaller to keep the cord from chafing on the metal.

To mount the socket, drill a suitable cork ¾" for a ⅛" pipe nipple 3" long. Apply household cement generously to the drilled hole, the nipple, the cork, and inside the jug neck. Then, with the cord drawn through both the jug and nipple, press the cork in. Before doing this, however, pour in sand or similar material as necessary to weight the jug.

After a socket has been threaded atop the nipple and the cord leads attached, conceal the nipple by winding heavy cord, raffia, wire, or other material around it. Alternatively, you might simulate a candle as suggested in the drawing.



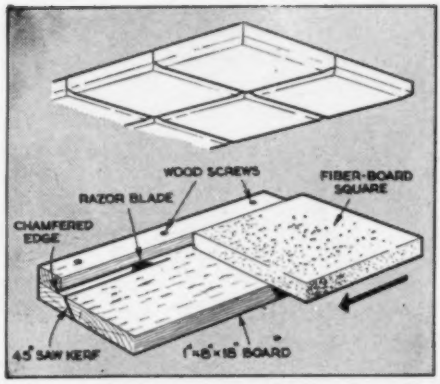
Slowly does it! While cutting a hole with an engraving tool, chip off the material bit by bit.



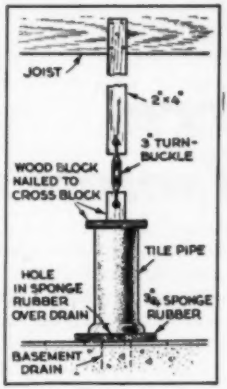
Wind cord or similar material around the pipe nipple, or simulate a candle as in the drawing.

Jig Trims Fiber-Board Edges

If you've ever worked with soft fiber board or insulation board, you know how difficult it is to trim the edges neatly, particularly in cutting up squares for finishing a ceiling. With a trimmer made as shown, however, you can get clean, uniform edges comparable to those of commercially made squares. Cutting action is provided by an old razor blade clamped in the 45-deg. saw kerf by means of two wood screws driven in from the rear edge. It should just touch the upper arris of the chamfer. Keep fingers well away from the razor blade when you are pushing work through.



Standpipe Stops Floods



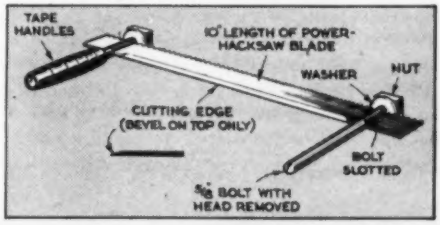
Water backing up in the cellar drain repeatedly flooded my basement until I devised this solution. A piece of sponge rubber with a hole in it is placed over the drain to act as a gasket. On top of this stands a section of tile pipe with a wooden cross block on the top. To this is nailed an upright that is fastened through a turnbuckle to a joist. The turnbuckle is used to apply enough downward pressure for sealing at the floor. When the drain is needed, I unscrew the turnbuckle and lift off the tile and rubber. The upper assembly can be pivoted so that it may be hooked to the ceiling.—W. E. Danneman.

Tennis Shoes Prevent Skidding

Ladders placed on wet, sloping, or hard surfaces, or on ground that may allow the legs to slide or move, present a serious menace both to the user and to anyone else who may happen to be close by. You'll have far less risk of skidding if you use a pair of worn-out tennis shoes as ladder accessories. Simply plant the ladder inside the shoes for a good grip.—Pat Fey.

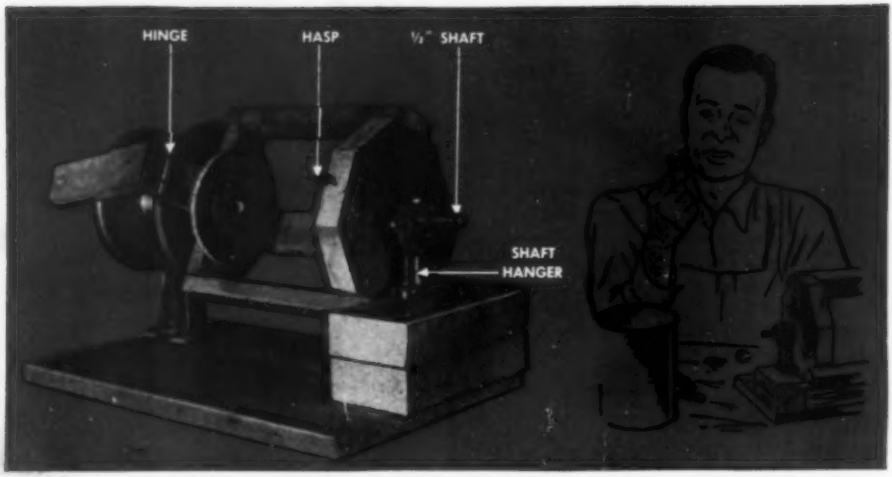
Engraving from Single Pattern

When you want to repeat an engraved pattern on a number of glass articles, the usual method of engraving or grinding right through the paper pattern is undesirable because it destroys the paper. Instead, fasten the pattern inside or under the glass so that it can be transferred unharmed to another piece.—Arthur Beiser.



Saw Blade Used for Draw Knife

One of the handiest woodworking tools, the draw knife, is also one of the hardest to find in the smaller sizes. Two bolts and a broken power-hacksaw blade, however, can solve that problem. Remove the bolt heads and saw slots in the threaded ends. Grind a cutting edge on the back of the blade and secure the ends in the slots with washers and nuts.



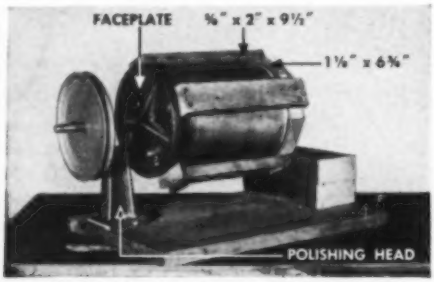
Tumbling Barrel Saves Craftsman's Time

Castings are cleaned, metal parts polished, and paint thoroughly mixed by this simple workshop tumbler.

By Frederic B. Leach

PRECISION tumbling proved its value during the war as a means of deburring and surface-finishing gears, castings, and miscellaneous metal parts—work previously done largely by hand with bench or portable grinders. In the home workshop, a small version of the industrial "rattler" likewise will quickly pay for the effort and time expended in making it.

As its name suggests, a tumbling barrel, or mill, revolves and jumbles together objects and material placed inside the chamber. When this jumbling takes place in the midst of an abrasive medium, the tumbled parts are cleaned or polished with an efficiency difficult to attain by hand.



A gallon can encased in a wood cradle serves as the chamber. Mount the cradle in this way.

Built around a 1-gal. paint can, the mill illustrated here gives good service in cleaning small castings, polishing metal parts, grinding pigments, mixing paint, and various other workshop tasks.

Since paint cans may vary in dimensions, depending on the manufacturer, it is well to have a can on hand before building the wood cradle in which it is slung, for the can must be held firmly while rotating. Attach one end of the cradle to a faceplate by means of two wood strips ⅝" thick and 2" wide half-lapped in the form of a cross having three equal arms and one that is ⅝" longer. Do this by cutting one strip 6¾" long and the other 7⅜". Fit a hinged slat to the long arm and screw three other slats, each measuring ⅝" by 2" by 9½", to the ends of the other cross arms. Fasten a disk of ¼" plywood 5" in diameter to the cross strips for added strength.

An octagonal wood block 1⅛" thick and 6¾" across serves as the other end of the cradle, a brass bushing being fitted in the center to receive a ½" diameter shaft. Screw

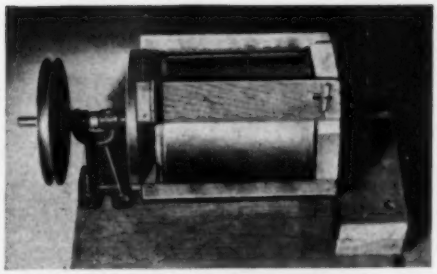
the three stationary slats to this octagon to allow just enough space for the paint can, and install a hasp to hold the hinged slat. This end of the cradle is supported in a bearing that sits on two pieces of two-by-four.

A tumbler must operate at very slow speed or centrifugal force will throw the contents against the walls of the container and eliminate the tumbling effect. Consequently, since the usual workshop motor operates at about 1,750 r.p.m., it is necessary to step down the speed.

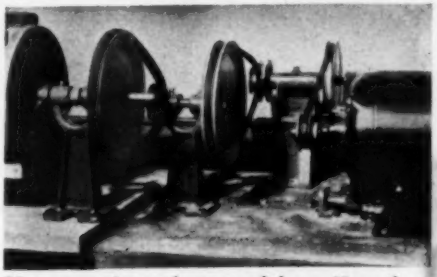
In this case, three steps were used, the pulleys being mounted on a lathe spindle and two polishing heads. In each step, the small pulley is 2″ in diameter; and the larger ones are 5″, 7″, and 6″, respectively. (These were used because they were at hand; three 6″ pulleys would have given about the same effect.) Instead of ½″ V-belts, two of the belts are only ⅜″ wide; hence, they fit closer to the center of the pulleys and increase the ratio. This gives a speed of about 35 r.p.m. Because of the considerable reduction, a motor of quite modest power can be used.

If you find that the tumbled material tends to remain at the bottom of the can, narrow cleats fastened lengthwise inside may overcome the difficulty. Alternatively, you could install an entire inner surface of wood, making it flat sided; or hammer five or six flat areas in the can itself.

Small steel balls will give sufficient abrasive action to clean small castings. Or, instead of balls, you might use stars—small metal objects that look like jacks with which children play. When tumbled together, the castings knock the rough edges off one another and the balls or stars get at the smaller places, loosening any sand and smoothing the casting generally. A mush made of sand and water with a little soap added, or various commercial abrasives, also may be used.



Hinge one slat and fasten it with a hasp to allow insertion and removal of the paint can.

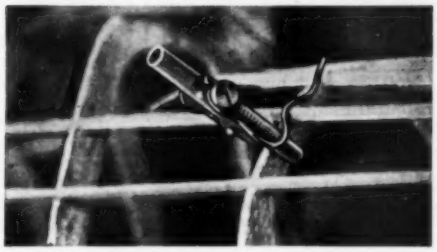


Motor speed must be stepped down. Here, three steps cut the tumbler speed to about 35 r.p.m.

When polishing is desired, various types of materials are suitable. For example, sawdust gives a high luster to some metals. In polishing, however, be careful to follow the instructions of the manufacturer of the polishing material being used, especially when plated metals are involved.

Artists who like to prepare their own materials will find the tumbling mill an excellent means of grinding pigments. In such cases, the material should be placed in the chamber along with a number of steel balls an inch or so in diameter. The continual pounding will grind the pigments very fine—fine enough even for water colors. In fact, the mill will pulverize almost any material that you may wish.

Radio Clips Used as Clamps for Model Building

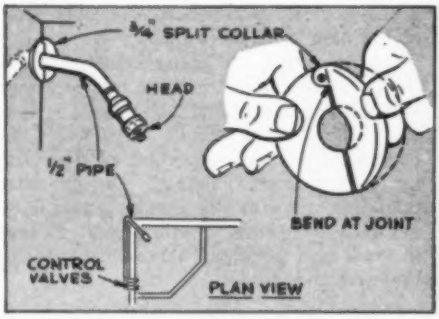


MODEL builders will find the alligator clips available at radio supply houses extremely useful as miniature clamps. The idea was evolved originally to hold stringers against the bulkhead of a model airplane, as seen here, but the spring jaws might also be used to clamp together adjoining pieces in the conventional manner. A short piece of stiff wire attached to the clip makes it more versatile.—OTTO WOOLLEY.

Roomy Trailer Built from Troop-Carrying Glider

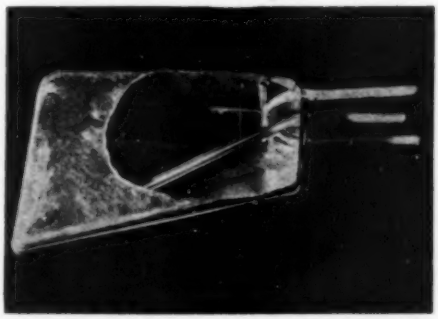
WHILE traveling across country these days you may occasionally spot a trailer that looks like this one. The chances are that it was once in the Army's fleet of troop-carrying gliders, now surplus.

Such gliders offer a head start toward a spacious trailer, for the cabin is 8′ high and 8′ wide. In the case illustrated here, the wings were removed, the fuselage cut off just behind the wings, and a plywood wall installed at the rear. Since the landing gear was too wide for highway use, it was removed. Wheels and fenders were installed at body width. A framework of heavy pipe at the front provides a sturdy hitch.—HENRY CLARK.



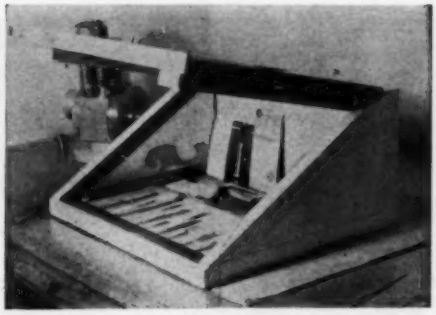
Collar Fits Corner Shower

CORNER shower stalls shaped like the one above call for a head projecting from the back corner. A common split collar can be used to finish off such an installation if it is bent near the pivot joint so that the halves form a 90-deg. angle. To compensate for the decrease in size of the hole as the result of bending, an oversize collar must be used, for instance a ¾″ collar on ½″ pipe.—J. MODROCH.



Fuel Tank Feeds to Last Drop

BECAUSE of centrifugal force, the fuel tank in a control-line model plane usually fails to feed the engine when the supply gets low, but here's a tank that overcomes this problem. As seen in the cutaway view above, the feeder line runs to the outer end of the trailing edge. Either of the two vent tubes may be used for filling. Made of aluminum, the tank was developed by Westchester Hobbies, Inc., White Plains, N. Y.



Drawing-Board Cabinet Houses Drafting Tools

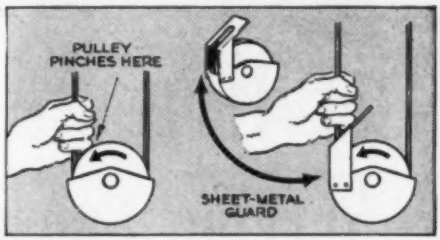
When occasional drawing is done in a home or office, the needed items often have to be found one by one. Here's a cabinet that keeps them together and also provides a sloping support for the drawing board.

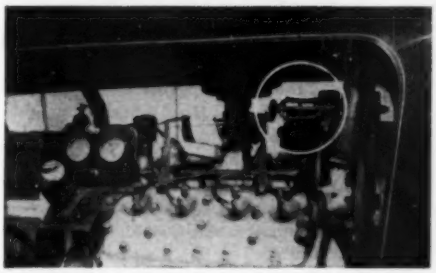
Triangular endpieces position the board, which is hinged and serves as a lid. The hinges are screwed to a small shelf that's handy for holding instruments during work. A ledge on the bottom of the board keeps T-square and triangles from falling off.

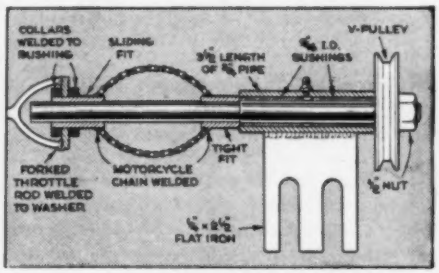
If you have a fitted case for your instruments, it can be fastened directly to the bottom of the cabinet, leaving plenty of room for triangles, scales, and other accessories. A paper rack might be mounted on the underside of the drawing board. If the room isn't well lighted, a bracket or gooseneck lamp can be affixed to the back or side of the cabinet.—J. C. Magee.

Shield Is Safeguard on Pulley

It's all too easy to pinch a hand or finger in a rope pulley, especially if one has to watch something else. A slotted guard made of heavy sheet metal will prevent such injuries. It's a Y-shaped piece, with the leg slotted down from the crotch, and the arms bent back and riveted or screwed to the pulley housing.—Hans Schmidbauer.

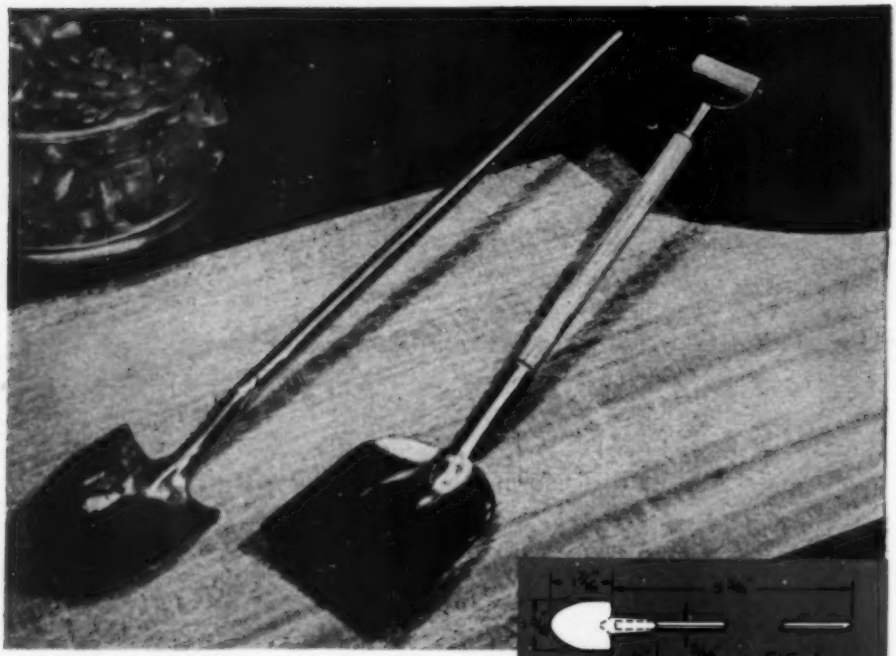


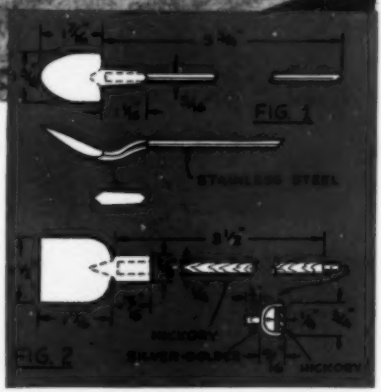




Chain Gives Fly-Ball Action on Engine Governor

Short lengths of motorcycle chain are the fly balls of an engine governor built by Arvid Kotanen, of Port Arthur, Can., as reported by The Hobart Brothers Company. Made to control a gasoline-powered welding generator, it consists of a pulley-driven shaft having a tight sleeve near the bearing and a loose one outboard. The chain lengths are welded to the two sleeves, and as they are bowed outward by centrifugal force draw the free-running one inward. Two washers welded to this have between them a free washer to which the throttle is attached. The bearing is a bushed length of ¾" pipe.





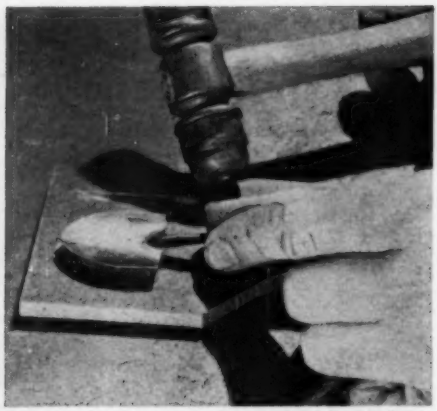
Tiny Tools Are Serving Spoons

Stainless-steel or silver miniatures will scoop up sugar, salt, candies, nuts, or other table delicacies.

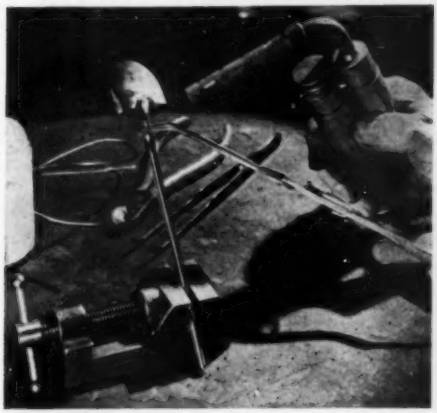
TABLE shovels are attractive novelties that invite lazy appetites to sample your party offerings. Both a long-handled shovel and short-handled coal scoop are pictured here, but there is no need to stop with this pair. Scaled ⅛" to the inch, any garden implement may model for your tableware. Individual salt shovels need be only about half this scale.

Stainless steel, sheet silver, aluminum, or similar material can be used provided the gauge is not too heavy. The long shovel is made as shown in Fig. 1. Cut the blade and the upper half of the handle socket in one piece. To shape the projecting shank so it will fit around the handle, rout a groove in a piece of composition board or fiber. Align the metal shank and a nail over the groove and strike the nail with a hammer. The groove should be about 7/32" in diameter and the nail about 5/32". Let the tip of the nail project into the blade area enough to form a slight depression there. Using the nail as a core, finish forming the shank, then bend it to the shape shown in the side view. Cut out a hollow of the proper contour in the composition board, turn the blade blank around, and hammer it into its concave shape with a round-nosed plastic hammer. Another method is to place a few layers of inner-tube rubber over the metal and shape it with a ball-peen hammer.

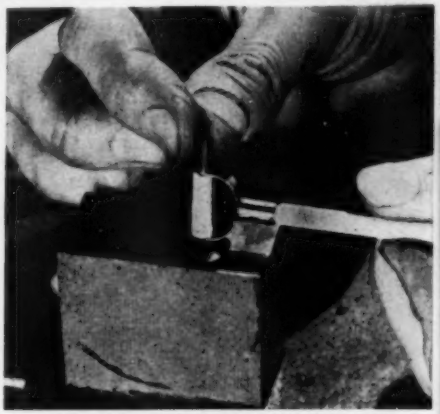
To shape the handle socket, rout a suitable groove, lay a nail over the blank, and hammer.



Form a recess in composition board and shape the shovel blank with a plastic-head hammer.



Handle and socket assembly are silver-soldered to the blade. Note that the joint is in back.



A noncorroding-wire rivet holds the wood grip in the U-shaped part of the handle assembly.

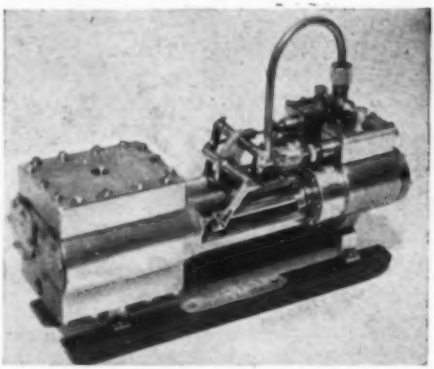
The other half of the handle socket is the mirror image of the first. A piece of 3/16″ stainless-steel wire is used for the handle. Shape it as nearly as possible like an actual shovel handle: rounded at the upper end, thinned a little along the upper half, and with the lower end necked down a bit and bent to fit the blade socket. By lightly silver-soldering the two halves of the socket to the handle along their centers, they will hold while the outer edges are hammered to a snug fit. Finally, apply silver solder to bond all pieces firmly and to fill any crevices that might be hard to clean.

The coal scoop of Fig. 2 has a hickory handle. Cut out and shape the blade and shank. The D-handle is formed by silver-soldering together a short tubular piece and a U-shaped piece and inserting a wooden rod between the legs of the U.

An old hammer handle will yield plenty of hickory for the handle. Split out a piece and drive it through a ¼″ hole in a steel plate. Sand the resulting dowel until it is smooth and round. Cut off a small piece for the grip where it will be held by a stainless steel or silver-wire rivet. The handle should be a drive fit in the blade and grip sockets; if necessary, tiny rivets can be installed for further security. Polish the metal with fine abrasive cloth or paper of 360 or 400 grit and buff it to a high luster on a cloth wheel charged with fine compound. You can give the wood a coat of antique-maple or similar stain, followed by two coats of clear lacquer.—WALTER E. BURTON.

Electric Scooter Runs an Hour on Single Charge

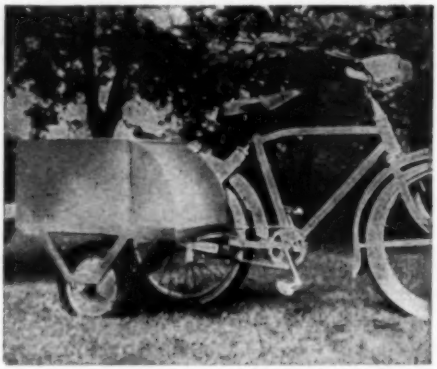
POWERED by an automobile starter motor, this child's electric scooter runs for more than an hour on one charging of its 6-volt battery. Built by John Albers, of Sioux City, Iowa, the scooter is operated by a switch button on the floor, an auto-starter solenoid being included in the circuit. A V-belt from the motor to the right rear wheel sends the vehicle along at a good clip, but not so fast as to be unsafe. A built-in rectifier charger may be plugged in (left above) to a 115-volt line to replenish the battery.



Tiny Steam Pump Lifts Liquid

THIS double-acting twin-cylinder model steam pump will lift a liquid for a height of 3′ and discharge it at the rate of a quart a minute. William H. Morrison, of Chester, Pa., is the builder.

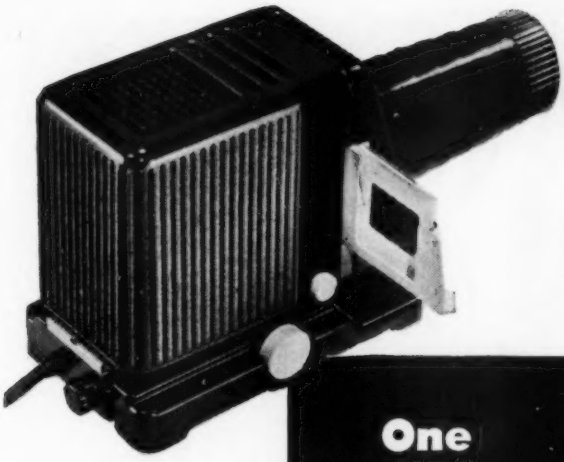
Made mostly of brass, it is 9″ long, 4″ high, and has a 1½″ stroke. The bore of the steam cylinders is ⅞″ while that of the pump cylinders is ¾″. Four suction and four discharge valves are located in the pump end. The pump operates either by steam or compressed air, and it runs so easily that it may be demonstrated simply by blowing into the line. Parts were machined from solid stock.



Bicycle Driven by Electricity

Two 6-volt batteries connected in series furnish the power for a side-car drive installed on a bicycle by George M. Shoppe, of Plainfield, N. J. The drive unit itself consists of a converted automobile generator that drives a 10″ semipneumatic ball-bearing wheel by a V-belt. A welded angle-iron frame is attached to the bicycle with two ⅜″ U-bolts.

Two switches provide control, one being operated by hand and the other by foot. Though capable of only modest speeds, the bicycle has a range of 30 miles between charges.



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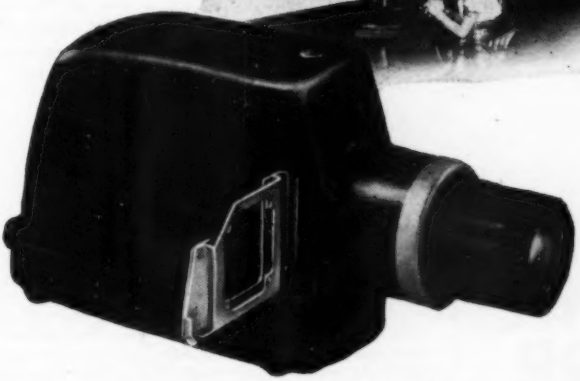

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Thread Length	7/32	7/32	5/32
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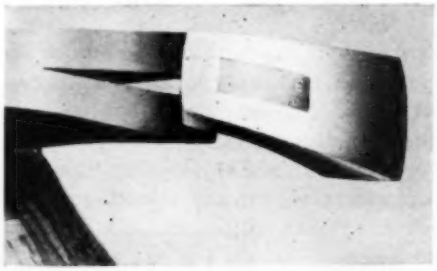

Hatchets from Hammers

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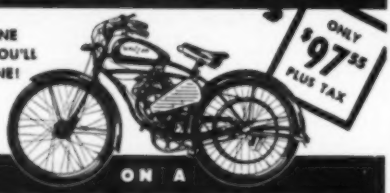

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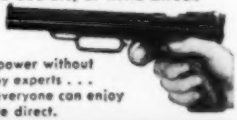

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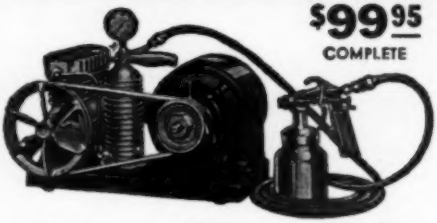

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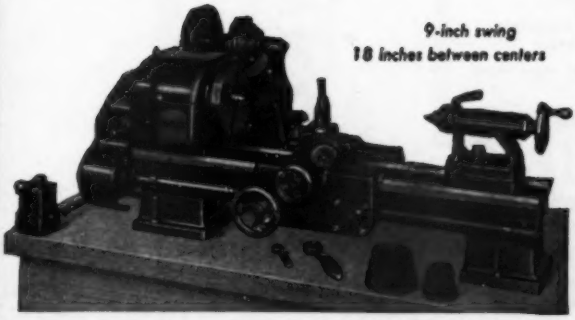

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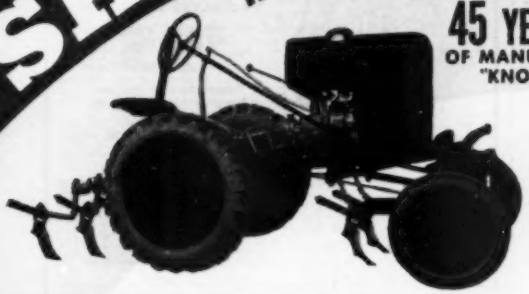

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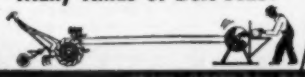

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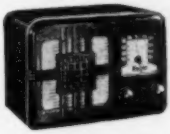

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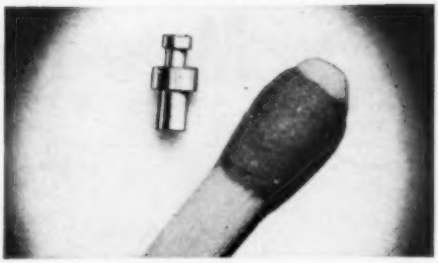

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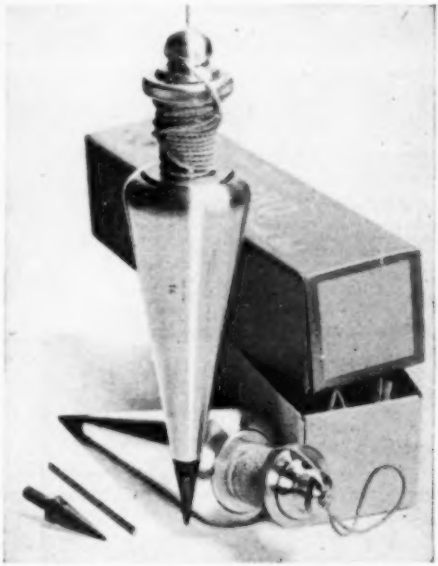
DWARFED by a matchhead, this miniature terminal lug is said to be the smallest machined lug in existence. It projects only 3/32 inch above a mounting board. Designed for use in miniature radios, hearing aids, meters and microphones, the Mini-Lug is marketed by the Cambridge Thermionic Corp., of Cambridge, Mass.



Hook Fixes Plumb Bob

PROVING that even the simplest tool can be refined, here's a Rolls-Royce version of the plumb bob. The Micro Bob is fitted with a rotatable reel and a special hook on top of the neck. When enough cord has been reeled off, it is slipped onto the hook, which holds the bob exactly in place anywhere on the cord. For fine adjustments, the spool is rotated.

HOW TO KEEP *LIGHT STREAKS* OUT OF YOUR SNAPSHOTS

SO YOU did it again. You were so sure this was going to be the best "shot" yet! But, no . . . it's just another snapshot full of light streaks. That indicates there may be holes in the bellows of your camera. There's an easy way to find out. Use your trusty flashlight. Better be sure your flashlight is powered with "Eveready" batteries. Powerful, dependable, *they outlast all other brands!**

GET OUT YOUR FLASHLIGHT. Take the back off your camera, as you do to put in new film. Then project the head of the flashlight just inside. The remaining exposed area of back should be covered with a cloth—the shutter should be closed. If you turn on the flashlight in a dark room, any holes in the bellows will be exposed immediately.

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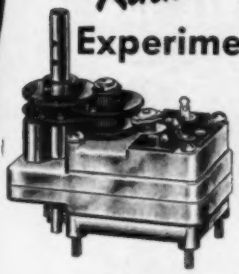
Experimenters Motor



Compact induction type AC motor operates from 25 to 30 volts AC, 60 cyc. Motor speed 2400 rpm with gear train driving ¼" shaft at 24 rpm. Thermal cutout prevents overload damage to motor. Measures 2x1¾"x3", excluding shaft which is ¼" dia. extending 2⅞". C14699 ..... $2.50

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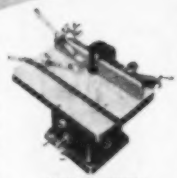

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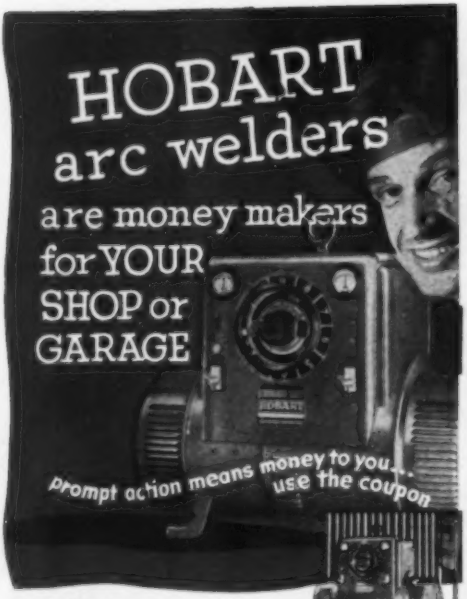

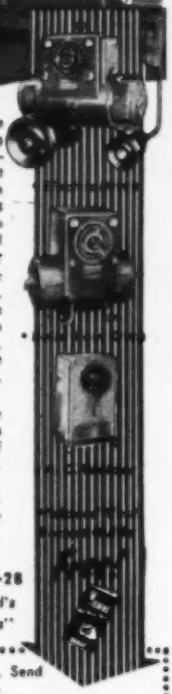

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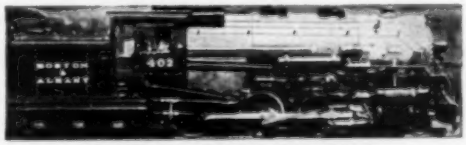

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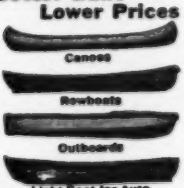

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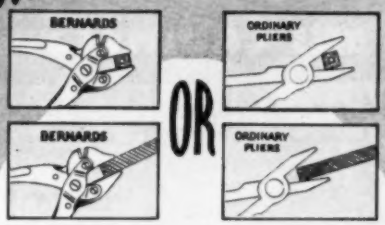

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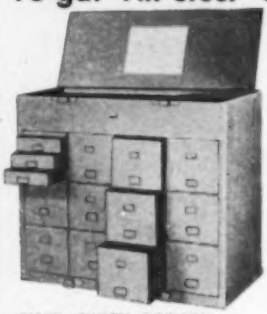

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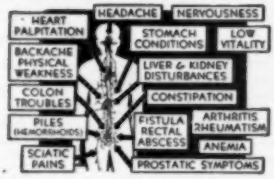

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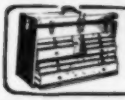

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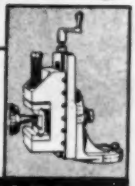

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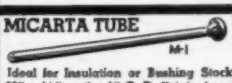

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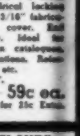

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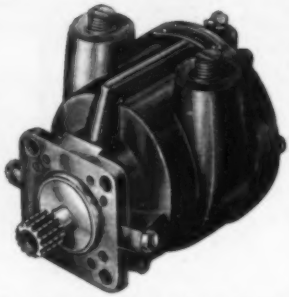

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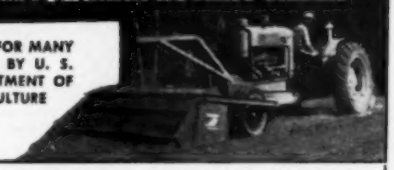

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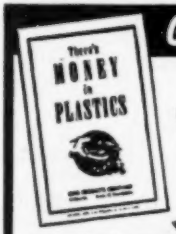

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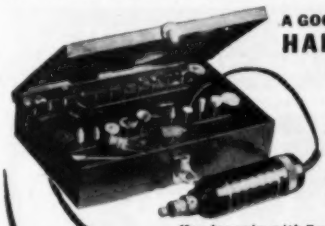

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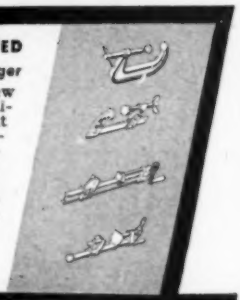

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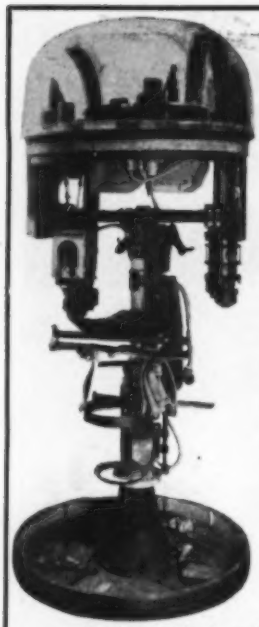

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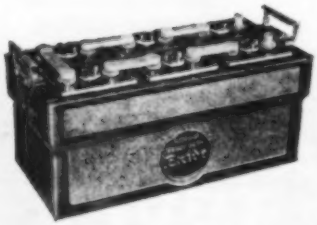

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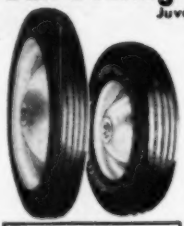

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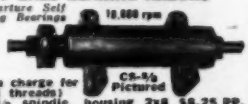

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For COAL FURNACE BLOWERS (Save 31% on Coal Bill)—AIR CONDITIONERS — HUMIDIFIERS —DARKROOM DRIERS— LABORATORIES—WORKSHOPS — HOSPITALS — LAUNDRIES — OFFICES — PRINTERS.

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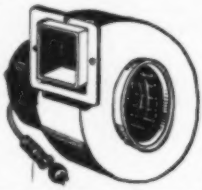

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$52.50
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Here's what you get—All steel chassis. Welded joint reinforced with steel plate for sturdy construction. Draw bar extends under body. 2 Standard type auto springs; with swivel joint shackle and fixed shackle. 2 Wire spoke wheels (that take standard 4.75 19 tires) 4 timken roller bearings, 2 dust caps, bolts for assembly. Knocked down, less body and tires.

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100 diameters magnification. (10,000 area magnification) 3 inch diameter steel main tube 50 inches long. Brass focusing tube. Tripod 6 feet high. Equatorial mounting. Ready to set up and use. Full power and clear vision guaranteed. Price $15.00. 20% deposit on C.O.D. orders.

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By simply placing boards across the top, you have a bench or table. Provides cross bars for adjustable shelves. Add ply-wood doors to shelves and you have a cabinet. O.D. 24"x30"-2¾" chanel steel. Finished in gray. You'll find many uses for these legs.

$4.75 ea. F.O.B. Yonkers
Minimum order 2 Legs

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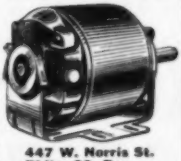
NEW POST WAR HEAVY DUTY MOTOR

1/3 H.P. G.E.
60 cycle
115 Volt A.C.

Special **$21.95**



This is not war surplus, but brand new postwar heavy duty G.E. motor with rubber mounted base. Powerful for drill presses, saws, lathes, air compressors, etc.
Extra heavy duty motor, ½ HP $39.95
Shipped Railway Express, Check or Money Order, COD Orders $5.00 deposit.

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Does All This with LESS Work!

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TWIN CARBURETION UNIT

Available for installation on any car with down-draft manifold.

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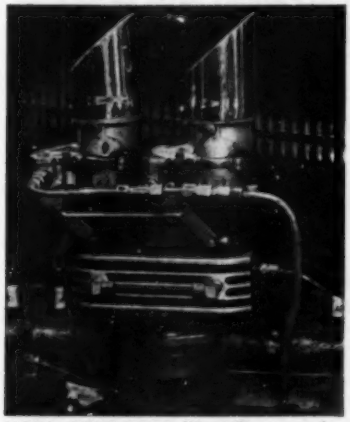

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6 cylinder cars $32.00 postpaid

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DESIGNED TO DO HIGH GRADE WELDING *inexpensively*—Maintenance Men, Farmers, Mechanics, Machine Shops, Foundries, Auto, General Repair and Job Welding Shops, all using the DYNAMIC find it so indispensable and useful that they can't afford to be without it. **EASY-TO-OPERATE.** If inexperienced you can easily learn to do a variety of high grade welding jobs by following the practical, *simplified Welding and Operating instructions furnished.* Once you see the DYNAMIC in operation you won't want to be without it. Its simplicity will amaze you. In a year the DYNAMIC only costs you about 7¢ a day. Comes complete ready to operate with helmet, rods, cable, holder, operating and welding instructions, etc.

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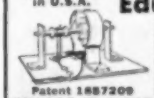

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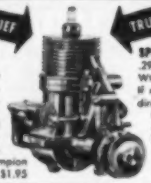

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COSTS ONLY 1/2 AS MUCH

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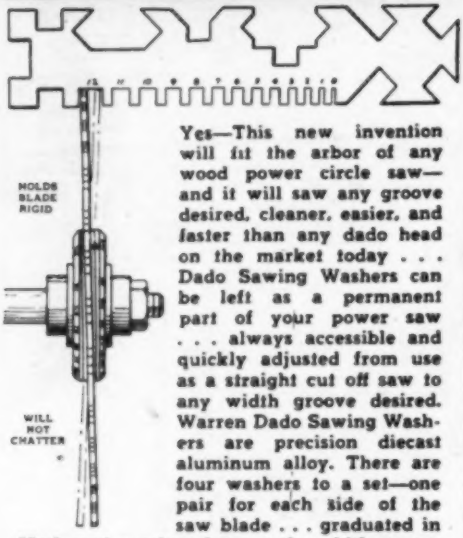
Easily — Quickly — Accurately



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On a standard size saw arbor using a ten inch saw blade with correct size arbor hole the maximum side movement without injuring saw or machine bearings is ⅝ inch.

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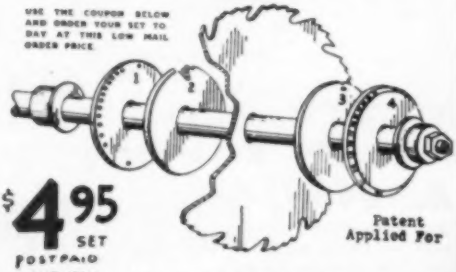

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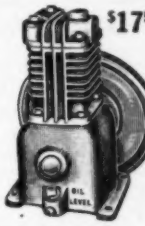

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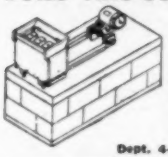

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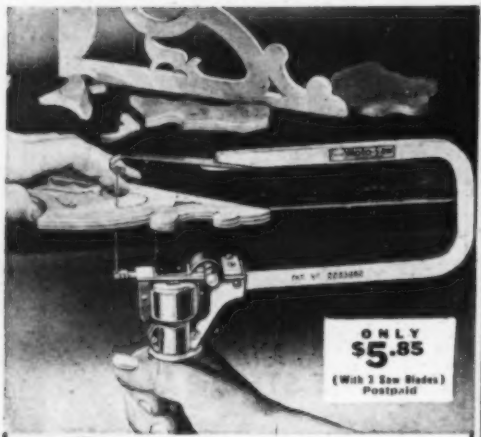

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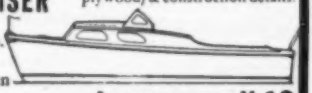

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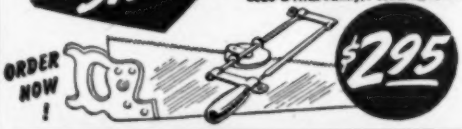

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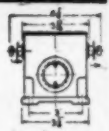

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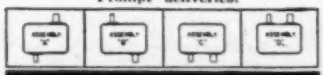

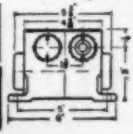

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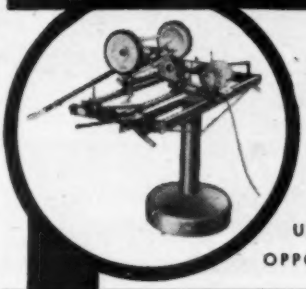

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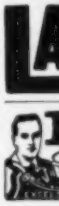

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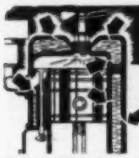

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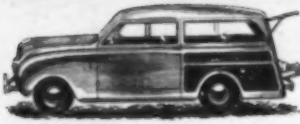

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Nowhere will you find a boat that will give you more for your boating dollar. Wagemaker "Wolverine" Boats set the pace for performance and reliability, at prices you can afford. Many Molded Plywoods in 12'-14'-16' lengths in De Luxe and Super De Luxe Models. Also popular Round Bottom Strip Boats. Over 60 models, a boat for every purpose. Free literature. Why not attend International Sports, Travel and Boat Show, Chicago, February 27 thru March 7, 1948. The only show approved by the Outboard Boating Club of America.

WAGEMAKER COMPANY
Dept. 26 Grand Rapids, Michigan

CARBIDE SCRIBER

L&M NON-MAGNETIC

FOR HARDEST STEEL, GLASS, ETC.

Tungsten Carbide—the hardest metal made by man—carefully ground on diamond laps, brazed into stainless steel 6" handle for marking steel and other metals—for etching, marking, cutting glass. Cuts all directions. Easy to follow any contour. In plastic case with pocket clip.

$2.00 PRICE POST PAID

Dealers, Distributors and Salesmen Wanted

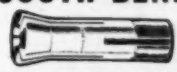
LUCAS-MILHAUPT ENGINEERING CO.
5051 SOUTH LAKE DRIVE • CUDAHY, WISCONSIN

Woo-Wee wolf whistle AUTO HORN

Reproduces "Wolf Whistle" better than any sailor. Screeches, barks, whistles, imitates siren, moves any "road hog" off the highway in "double quick plus." Attract more attention than by driving a yellow Cadillac. Operates from manifold. Installed on any car in 15 minutes. Sturdily constructed. Cleverest novelty since the use of the auto. Be the first user in your neighborhood. Dealers wanted. Absolute money back guarantee. 6 dollars each. Order today. Ohio orders add 3% tax.

THE PROTECTUROD COMPANY - Dept. 102
4033 Windsor Road · Youngstown 7, Ohio

SOUTH BEND LATHE COLLETS



Steel and *Brass* Collets for use in any make of lathe or other machine that they will fit.

SPECIFICATIONS

Collet No.	Thread Dia. In.	Thread Length In.	Th'ds Per In.	Body Dia. In.	Collet Length In.	Head Dia. In.	Head Taper Deg.
3	.650	3/4	26	.6495	2-11/16	.852	12
2	.855	13/16	20	.8595	3-5/16	1.095	15
5	1.250	3/4	20	1.2495	3-9/32	1.452	10
4	.950	13/16	20	.9495	3	1.150	10

	No. 3	No. 2	No. 5	No. 4
STEEL COLLET	$3.75	$4.00	$4.75	$4.25
BRASS COLLET	2.00	2.25	2.50	2.35

SOUTH BEND LATHE WORKS 456 E. Madison St. South Bend 22, Ind.

TESTED DRILL PRESS TOOLS FOR HOME CRAFTSMEN

MULTI-PURPOSE WOOD PLANER

Fits any drill press. Exclusive hi-speed blade design performs precision surface planing, rabbeting, tenoning, paneling, grooving, routing beading. Thousands now in home workshops, schools, cabinet and pattern shops. An indispensable lifetime tool for wood and plastic workers. Complete $7.50

NEW STYLE DRUM SANDER

Fits any ½" drill press chuck. Used for sanding curves, contours, straight edges. Has many essential workshop applications. Complete with 5 spiral sanding sleeves..... $3.95

4" ROTARY SURFACE SANDER

An exclusive type sander for drill presses, flexible shafts, motors, hand drills. Instantly sands woods, plastics and metals to agate smoothness. No waves, ripples, striations. Discs immediately interchangeable. With 20 discs... $5.95

ALL METAL SHAPER FENCE

Precision built of hard alloy aluminum and steel. Nothing to rust. No wooden parts to warp. For moulding, jointing, shaping, rabbeting, tenoning. Fits all standard drill presses—shapers. Complete with two hold down springs. A real buy at $7.95

AT YOUR DEALER—OR ORDER DIRECT

FREE Workshop Catalog →

BARRON TOOL COMPANY, INC.
270 Architects Bldg., Detroit 1, Mich.

BARRON PRECISION WORK SHOP **TOOLS**

Now for EVERY WORK SHOP!

NEW Invention **Electroplates by BRUSH**

Easy to Plate CHROMIUM GOLD, SILVER, NICKEL, COPPER

. . . For Pleasure and Profit!

If you have a workshop—at home or in business—you need this new Warner Electroplater. At the stroke of an electrified brush, you can electroplate models and projects—you can replate worn articles, faucets, tools, fixtures, silverware, etc. with a durable, sparkling coat of metal . . . Gold, Silver, Chromium, Nickel, Copper or Cadmium. Method is easy, simple, quick. Everything furnished—equipment complete, ready for use. *By doing a bit of work for others, your machine can pay for itself within a week.* So make your shop complete by getting a Warner Electroplater right away. Send today for FREE SAMPLE and illustrated literature. ACT AT ONCE! *Mail Coupon.*

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for shop men and homecraftsmen.

Write for literature on this versatile, low-cost, sturdy line.

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944 Central Ave., Toledo 6, Ohio

BUILD YOUR OWN TRAILER

Get these Modern Complete Plans

Select just the model you want—for hunting—travel—camping—or as a home. Each plan is complete with simple, step-by-step instructions and a bill of materials. Easy to follow. Three models!

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Special—Order all 3 of above plans.....$2.00

FREE! *Big parts catalog with any order*

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Dept 9 Box 2353 Terminal Annex Los Angeles 54, Calif.

TALK-SING *thru your own radio with* **RADIO MICROPHONE**

Be the life of the party. Put on your own broadcasts at home. Talk—Sing, make announcements from any room. Wonderful voice practice. Microphone easily attached to any radio. Follow enclosed instructions. SEND NO MONEY—pay Postman $1.98 plus postage. Send Money Order or check and save postage.

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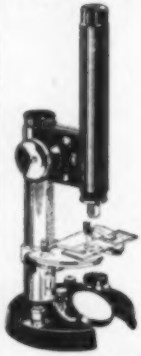
NEW CHEMICAL MITT

Sensational! DRY Window Cleaner! Uses no water, no messy liquids. Chemically Treated. Simply glide over windows; leaves glass sparkling clear. No heating water, no heavy buckets to carry. No rags, powders, sponges, chamois. No mess or muss. No red chapped hands. Dust, dirt, grime, fog disappear like magic. *Wonderful for auto windows, windshields!*

SAMPLES FOR AGENTS Sample offer sent immediately to all who send name at once. A penny postal will do. SEND NO MONEY—*just your name.* **KRISTEE CO., 699 Bar Street, AKRON, OHIO**

PAN-TEK 192-POWER MICROSCOPE

$39.50



Complete with two eyepieces, separable objective, substage condenser and duplex mirror.

Fully corrected to give the four magnifications of 24X, 48X, 96X and 192X, with resolving power and size and flatness of field unsurpassed by laboratory instruments costing several times this price.

All-metal construction, finished in baked enamel, nickel and chromium.

Price, postpaid in U.S.A. $39.50
($10.00 deposit on C.O.D.'s)

Trade inquiries invited

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Now She Shops "Cash And Carry"

Without Painful Backache

Many sufferers relieve nagging backache quickly, once they discover that the real cause of their trouble may be tired kidneys.

The kidneys are Nature's chief way of taking the excess acids and waste out of the blood. They help most people pass about 3 pints a day.

When disorder of kidney function permits poisonous matter to remain in your blood, it may cause nagging backache, rheumatic pains, leg pains, loss of pep and energy, getting up nights, swelling, puffiness under the eyes, headaches and dizziness.

Don't wait! Ask your druggist for Doan's Pills, a stimulant diuretic, used successfully by millions for over 50 years. Doan's give happy relief and will help the 15 miles of kidney tubes flush out poisonous waste from your blood. Get Doan's Pills.

VU-VIZOR *The New*

TRANSPARENT PLASTIC SUNSHADE

* Enables you to see traffic lights. Also cars ahead while driving down grades. Eases night driving. Designed to conform to contour of your car. Carefully constructed of the heavy transparent plastic used in aircraft. Polished stainless steel brackets hold shade rigid to car. Will not tear or rust. Readily mounted on all models. Shipped complete with all necessary screws, nuts, etc. for easy permanent installation. State make, model and year of car.

Send order direct or write for literature **$38.95**

NU-WORLD PRODUCTS CO. F.O.B. Huntington Beach, Calif.

303 Third St., Dept. PS-2, Huntington Beach, Calif.

ELECTRIC SHEAR SHARPENER

OVER 35,000 SOLD—IT MUST BE GOOD!

Genuine Carborundum wheel ideal for shop or home use. Send remittance with order and shipment will be made at once, prepaid to your door complete with electrical goods catalogue.

$9.75 complete with vise

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LEARN IN 12 WEEKS TIME

In 12 weeks time you can own your own shop or earn big income as skilled shoe repairman. Growing demand everywhere at top wages for men who know how. We teach you quickly by actually working on shoes and modern machines. Costs nothing under G.I. Bill of Rights. We help you get big pay job or start your own shop in 12 short weeks. School open to all from 18 to 60 years of age. FREE BIG 16 PAGE BOOK explains everything. Send for your copy today.

MODERN SHOE REBUILDING SCHOOL, *Established 1927*
2937 Belmont Ave., Chicago, Ill. RUSH POSTCARD TODAY!

MAKE *sure* OF BETTER PICTURES

2 great G-E meters to help you!

Get perfect shots every time . . . movies or stills. Easy with either one of these great G-E exposure meters. Tells you how to "set" your camera for full detail, rich color. Simple to use. Ask your photo dealer. *General Electric, Schenectady 5, N. Y.*

Famous Type DW-58. Extremely accurate. Sturdy. Dependable. A big value for only **$19.95*** Federal tax included.

New! Deluxe Type PR-1. Remembers the light it sees . . . sensitive, compact, easy to use. Ask for the meter with a MEMORY! **$32.50*** Federal tax included.

*In states where Fair Trade Contracts are in effect.

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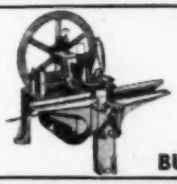


AUTOMATIC SAW SET

Set saw teeth automatically on hand or band saws—400 per minute without effort. Perfect hammer and anvil action sets teeth uniformly—no tooth breakage.

★ **IMMEDIATE DELIVERY WRITE TODAY**

AUTOMATIC RETOOTHER

Cuts new saw teeth in 50 seconds—any size 4 to 16 points. Old teeth fall off as chips. Easy to operate. A perfect job.

FOR HAND SAWS

BURR MFG. COMPANY, 8943-N Venice Blvd., Los Angeles 34, Calif.

FREE Sample Of New PLASTIC Shows How To Make Leather *and* Leatherette *LIKE NEW!*

MAGICALLY CHANGES CLOTH TO IMITATION LEATHER

SAVE MONEY - TIME AND EFFORT by renewing Luggage—Leather Covered Furniture—Golf Bags—Auto Seat Covers—Restaurant Furniture, Booths or any Leather or Leatherette item with new plastic discovery called Leather-New. Coat cloth or cloth covered items such as Glider Cushions, Tarpaulins, Porch Furniture, Etc. and make them look and wear like they were leather. Spreads easily with brush or spray gun—leaves NO BRUSH MARKS. Simple Acids, Caustics and Alcohols do not stain this finish—It is sun and mildew proof. Stays Fresh and Clean as long as real leather. Comes in all standard colors. Just mail coupon for Free sample of Leather-New coated material which shows effects.

OWN A PROFITABLE LIFETIME BUSINESS

Cash in on big profits to be made in this new business—Profits up to $700.00 monthly possible, renewing booths and furniture for bars, restaurants, grills, movie houses, etc. Mail name and address on 1c postcard—I'll show you how. **Jack Edwards, Sales Mgr.**

LEATHER-NEW PRODUCTS, Leather-New Bldg., 4723 Troost, Dept. S-2, Kansas City, Mo.

JUST MAIL COUPON

No Obligation

Leather-New Products, Leather-New Bldg., 4723 Troost, Dept. S-2, Kansas City, Mo.

Name.....

Address.....

City..... State.....

Fill Out—Mail Today

TO: Reader
FROM: Editor

Plain Talk About The Tucker

QUITE a few readers have written me asking why POPULAR SCIENCE has never had a piece about the much-publicized Tucker car. Some letters mention the articles and photographs that have appeared in newspapers and in other magazines. Others ask what we think of the car and the innovations described in the advertisements.

This situation points a blunt finger at an important editorial commandment of POPULAR SCIENCE. This magazine aims to report not only what is new or what it means, but also *how it works*. So we have to know more than most publications to get a story into our kind of pictures and print.

A fine example of how we must answer to you readers (and the ever-present experts in everything among you) is the story of Buick's new Dynaflow in this issue. From the time we heard the first trade rumor that Buick was readying a really new kind of transmission, we knew this was our kind of meat.

We assigned a reporter. He checked through General Motors in New York, caught a plane to Detroit. He drove a car equipped with Dynaflow and was quickly convinced it was one of the biggest automotive stories ever.

But, while understanding *what* it does was easy, explaining *how* it works was one of the toughest nuts ever cracked with a typewriter and a sketch pad. Our man spent hours that stretched into days groping through blueprints, poring over texts on hydraulics, interviewing engineers, probing other manufacturers for reactions.

The same man has been chasing the Tucker story in the same way for months. So far, we haven't caught it. And it isn't because we haven't tried. We've had reporters scouting New York, Detroit, and Chicago. Our man poked around the polished exhibition chassis. He was told the power from the rear engine was delivered to the rear wheels through hydraulic torque converters. He asked how they worked. The Tucker people said it was a secret.

Now POPULAR SCIENCE has only the highest regard for the ambition of Mr. Preston Tucker to bring forth a new automobile that incorporates so many fresh approaches to the tough, old problems of design and engineering. We appreciate the economic difficulties of starting a new company and the production difficulties in getting a radically new car on the assembly line.

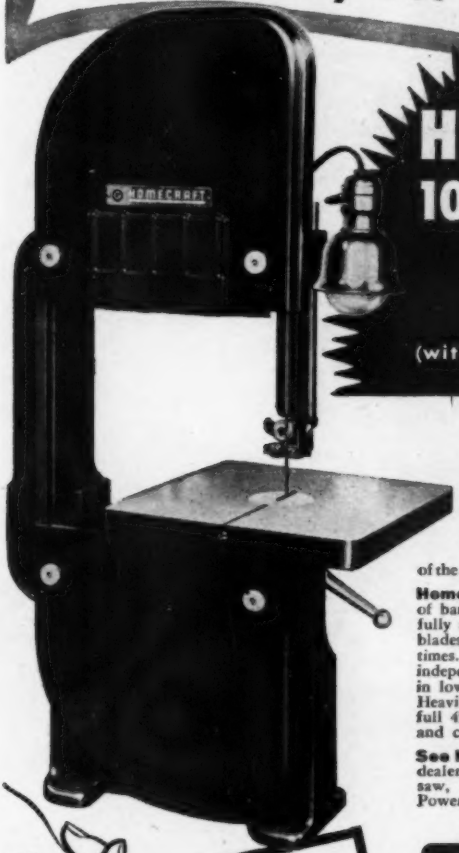
But the stock market and the steel market are not our editorial concern. Our field is the car, not the company. Dealing with the hard mechanics of how-it-works, even our best artist can't draw a picture of a claim. So until we can do a job like the Dynaflow story on the Torpedo, the envelope marked "Tucker" in our morgue will still carry a scrawled "NO STORY."

PG

Buick's Dynaflow

Tucker's Torpedo

New! Economy-Priced! Built expressly for the home shop!



HOMECRAFT® 10-inch Band Saw

No. 28-110

Only $36.95

(without motor or lamp attachment)

A practical hobbyist's band saw that has 6½" capacity under the guide and a throat capacity of 9⅝"

The 28-110 *Homecraft* Band Saw is an outstanding hobby-shop tool! It fulfills the demand for a good, dependable, popular-priced tool that fits the needs of the average hobbyist who "tinkers" with wood.

Homecraft features like this add up to a lot of band saw for the money: Blade guides are fully adjustable for different sizes and types of blades. Correct tension is kept on blade at all times. Ball-bearing blade support is adjustable independent of blade guides. Bronze bearing in lower wheel; needle bearing in upper wheel. Heavily-ribbed 10" x 10" cast-iron table tilts full 45° for angle-cutting, has convenient scale, and can be securely locked in place.

See It At Your Dealer! Ask your *Homecraft* dealer to show you this No. 28-110 new band saw, and his complete display of *Homecraft* Power Tools priced from $29.95 to $39.95.

Visit your Homecraft dealer now!

Tilting table locks quickly and securely in place. Convenient scale tells you the angle of tilt.

Wheel-tension and blade-tracking adjustments provide handy means of aligning blade and keeping correct tension at all times.

For safety, protection is provided by front blade guard which adjusts up and down with blade guides and ball-bearing blade support.

HOMECRAFT POWER TOOLS

are built by the makers of the famous Delta-Milwaukee Power and Machine Tools, the acknowledged leaders in accuracy, safety, and dependability. Thousands of Delta tools are used today in industry, in schools, and in home shops too. So, if your goal is the finest shop obtainable, equipped with high-quality power tools that embody the very finest principles of engineering, design, and construction, then insist on Delta-Milwaukee Power Tools.

*Trade Mark Reg. U.S. Pat. Off.

HM-58

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HOMECRAFT® POWER TOOLS

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Descriptive Literature! Shows all Homecraft Power Tools and accessories. Sent to you free. Use coupon below, to get your copy.

Tear out coupon and mail today!

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Please send descriptive literature on **Homecraft** Power Tools.

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NEW!

SOUTH BEND 14" Drill Press

South Bend presents this new 14" Drill Press as a companion to the South Bend Precision Lathe. It is built with the same high standards of accuracy and skilled workmanship. Years of painstaking research and experimentation have gone into its designing. This has resulted in a superior tool that is unsurpassed for accuracy, ease of operation, versatility and dependable performance.

FEATURES and SPECIFICATIONS

BELT TENSION RELEASE
Quick-acting belt tension release lever simplifies speed changes. Keeps tension correct.

BUILT-IN LIGHT
Provides shielded illumination for work area. Separate on-off switch.

SPINDLE
Free-floating design prevents misalignment, side thrust, and whip. Travel . . . . . 4"

BALL BEARINGS
Sealed, precision type. No oiling. 2 on spindle drive unit, 2 on spindle.

QUILL BEARING ADJUSTMENT
Compensates for wear.

DEPTH GAUGE
Graduated in inches. Adjustable collars control feed and return.

RUGGEDLY CONSTRUCTED
Precison-built for industrial and all other types of shops.

TWO MODELS
Bench or floor type.

CAPACITY
Maximum drill size in iron or steel . . . . ½"
Drills to center of 14" circle.

CHUCK
Capacity . . . . 0 to ½"

SPEEDS
Four—707 to 4322 r.p.m.

CHUCK TO BASE DISTANCE
Bench Model . . 17"
Floor Model . . . 46½"

TABLE SIZE
10" x 10" . . Tilt Type

COLUMN
2¼" diameter. Accurately ground.

HEIGHT
Bench Model . . . 35¼"
Floor Model . . . 65½"

SHIPPING WEIGHT
Bench Model . 195 lbs.
Floor Model . 235 lbs.

MOTOR REQUIRED
⅓ h.p., 1725 r.p.m. Vertical mounting. On-off switch provided.

$98.00 f.o.b. factory, with chuck, extension cord and switch; less motor.

SOUTH BEND LATHE WORKS

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SECOND EDI
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THE DOLLARS AND CENTS OF BUSINESS: Short cuts in business mathematics show how to calculate simple and compound interest; bank discount; savings through cash discount; trade discounts; averages; markup and selling price; annuities; sinking funds and amortization; depreciation; freight rates; verifying by check numbers; tables of weights, measures and values.

WRITE BETTER LETTERS: This section covers: a plan to improve letters; compiling a correspondence manual; letter appraisal chart; tone and spirit of letter; how to answer inquiry; refuse requests; revive inactive accounts; build goodwill; answer complaints; legal aspects of business letters.

HOW TO SELL BY DIRECT MAIL: Here is expert guidance on: selecting lists; types of direct mail; self-question chart of direct advertising; testing direct mail; how to record results; how to build mailing lists; how to write sales letters.

HELPFUL FACTS ABOUT ADVERTISING: Facts for small advertisers; developing demand; how to work with an advertising agency; fixing the

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NEW!

SOUTH BEND 14" Drill Press

South Bend presents this new 14" Drill Press as a companion to the South Bend Precision Lathe. It is built with the same high standards of accuracy and skilled workmanship. Years of painstaking research and experimentation have gone into its designing. This has resulted in a superior tool that is unsurpassed for accuracy, ease of operation, versatility and dependable performance.

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Quick-acting belt tension release lever simplifies speed changes. Keeps tension correct.

BUILT-IN LIGHT
Provides shielded illumination for work area. Separate on-off switch.

SPINDLE
Free-floating design prevents misalignment, side thrust, and whip. Travel . . . . . 4"

BALL BEARINGS
Sealed, precision type. No oiling. 2 on spindle drive unit, 2 on spindle.

QUILL BEARING ADJUSTMENT
Compensates for wear.

DEPTH GAUGE
Graduated in inches. Adjustable collars control feed and return.

RUGGEDLY CONSTRUCTED
Precision-built for industrial and all other types of shops.

TWO MODELS
Bench or floor type.

CAPACITY
Maximum drill size in iron or steel . . . . ½"
Drills to center of 14" circle.

CHUCK
Capacity . . . . 0 to ½"

SPEEDS
Four—707 to 4322 r.p.m.

CHUCK TO BASE DISTANCE
Bench Model . . 17"
Floor Model . . . 46½"

TABLE SIZE
10" x 10" . . Tilt Type

COLUMN
2¾" diameter. Accurately ground.

HEIGHT
Bench Model . . . 35¼"
Floor Model . . . 65½"

SHIPPING WEIGHT
Bench Model . 195 lbs.
Floor Model . 235 lbs.

MOTOR REQUIRED
⅓ h.p., 1725 r.p.m. Vertical mounting. On-off switch provided.

$98.00

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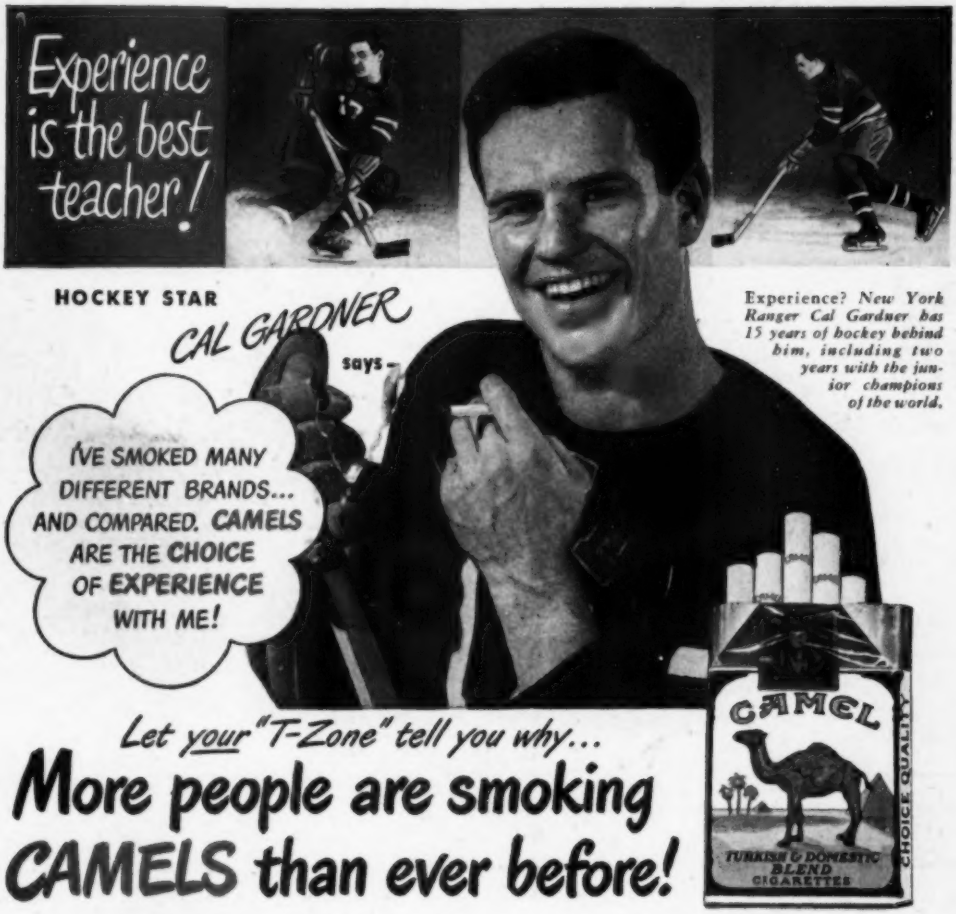

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